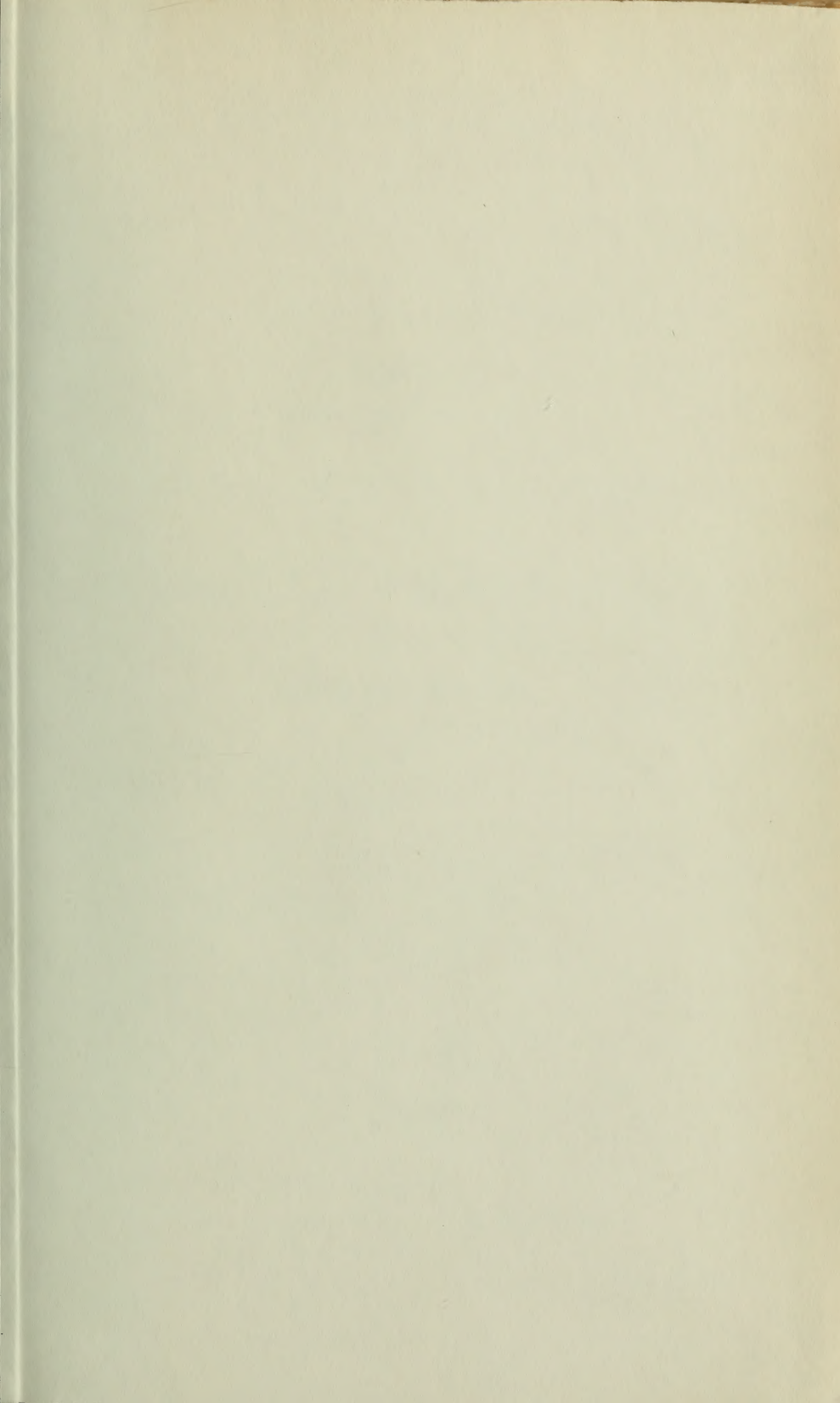


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Bulletin 104

ENTOMOLOGY 26

21ST Report of the State Entomologist

ON

INJURIOUS AND OTHER INSECTS

OF THE

STATE OF NEW YORK

1905

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PLATE 10

- 1 A drained breeding pool on salt marshes near Lawrence, L. I. This pool is some 30 or 40 feet from a ditch and illustrates nicely the efficacy of such drainage
- 2 A salt marsh ditch near Lawrence, L. I., with sloping sides and slanting bottom; a very unsatisfactory type.

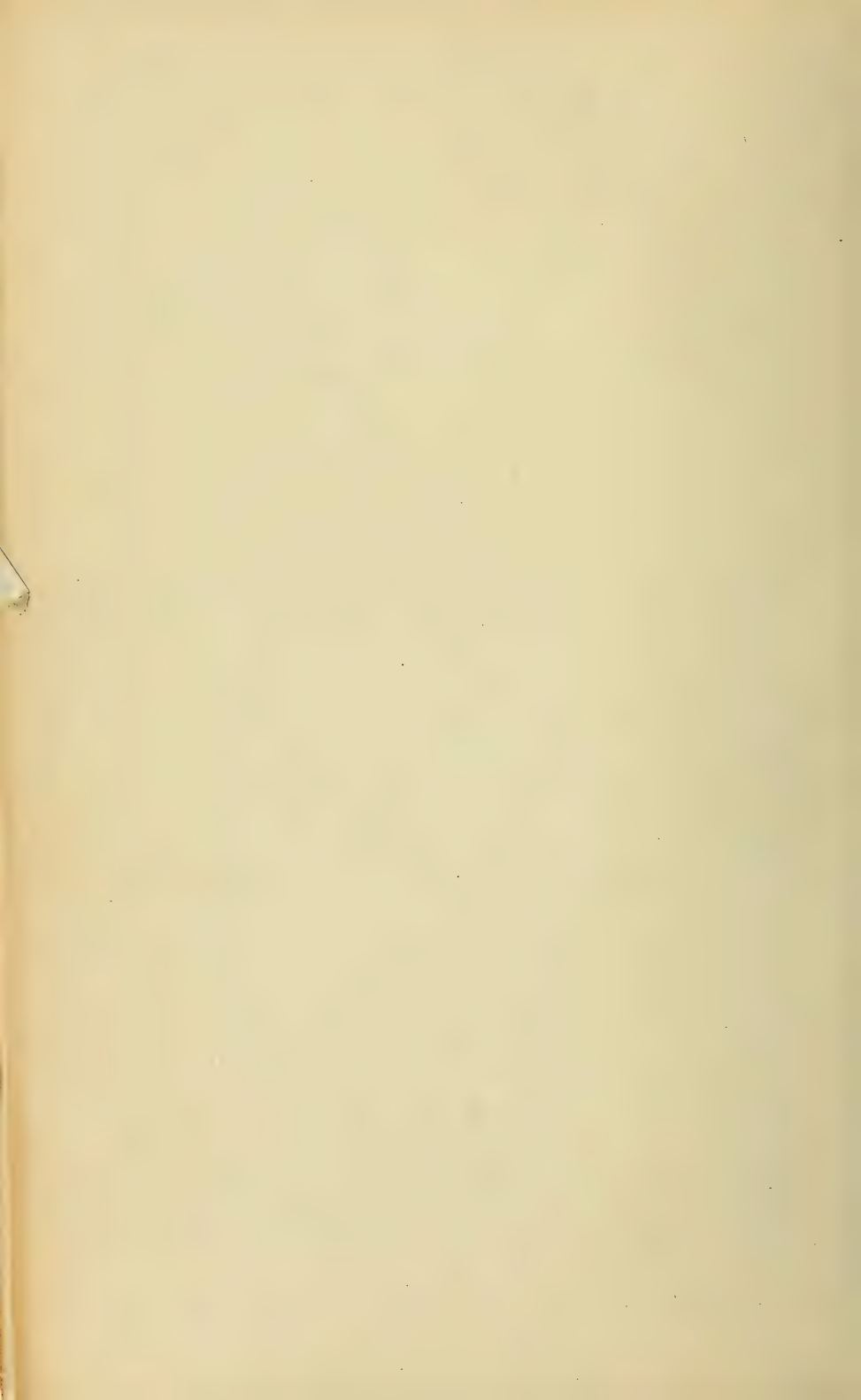


1



2

Drained breeding pool and an unsatisfactory ditch on salt marsh



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New York State Education Department

New York State Museum

JOHN M. CLARKE Director

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NEW YORK STATE EDUCATION DEPARTMENT

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- G2 (19) Merrill, F. J. H. Guide to the Study of the Geological Collections of the New York State Museum. 162p. 119pl. map. Nov. 1898. [50c]
- G3 (21) Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sep. 1898. 5c.
- G4 (48) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. 25c.
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Horticulture: Diseases and Pests. N. Y. State Lib. Bul. 87.
Legislation 22. 1904. p.015-016

Review of legislation relating to plant diseases and insect pests in 1903.

Scurfy Bark Louse. Country Gentleman, Nov. 24, 1904, 69:1076¹⁵

Brief account with remedies for scurfy bark louse, *Chionaspis furfura* Fitch, and San José scale, *Aspidiotus perniciosus* Comst.

A New Lime Sulfur Wash. Country Gentleman, Dec. 1, 1904, 69:1115¹²

Method of preparing the lime-sulfur sal soda wash without boiling, and results therewith.

How to Kill the San José Scale. Garden Magazine, Feb. 1905, 1:22-23

Brief general account of San José scale, *Aspidiotus perniciosus* Comst., with special reference to remedial measures.

New York State Fruit Growers Association. Report of the Committee on Entomology. Country Gentleman, Feb. 2, 1905, 70:106

Summarized account of experiments against grape root worm, *Fidia viticida* Walsh, and San José scale, *Aspidiotus perniciosus* Comst.

A New Way of Killing San José Scale. Garden Magazine, Mar. 1905, p. 76

The value of the lime-sulfur and sal soda wash and kerosene limoid spray as remedies for the San José scale, *Aspidiotus perniciosus* Comst., discussed.

Insecticides and Fungicides. N. Y. S. E. D. Handbook 18, p.1-18, Jan. 1905

Revised edition giving principal formulas.

Culex brittoni n. sp. Ent. News, 16:79-80

Original description.

Controlling San José Scale. Country Gentleman, Mar. 16, 1905, 70:261¹¹

Brief discussion of remedial measures; recommending a boiled lime-sulfur wash for the San José scale, *Aspidiotus perniciosus* Comst., with comments on the lime, sulfur, sal soda and other washes.

Getting the Poison Ready. Garden Magazine, 1:144³²

Formulas for lime-sulfur washes and poisoned bordeaux mixture.

Martins for Mosquitos. Country Gentleman, Mar. 30, 1905, 70:296²⁶

Importation of martins is discouraged because our native swallows are probably equally valuable in checking mosquitos.

Important Work in May. Garden Magazine, May 1905, p.200, 202

Methods of controlling common garden species with mention of arsenate of lead and kerosene emulsion.

Rose Beetles, Squash Bugs and Asparagus Beetles. Garden Magazine, June 1905, p.234³⁵

Brief directions for control of common pests.

To Corn Planters. Country Gentleman, May 25, 1905, 70:492²².

Also in Albany Evening Journal, Troy Times

Webworms, Crambus species, are unusually abundant and preventive measures for corn planters in particular, are given.

The Round Headed Apple Tree Borer. Country Gentleman, May 25, 1905, 70:501¹²

Descriptive life history of round headed appletree borer, *Saperda candida* Fabr., with methods of controlling it.

Webworm Depredations. Argus (Albany) May 28, 1904, p.4

Webworm Injuries. Country Gentleman, June 1, 1905, 70:513¹¹

A brief account of present and earlier injuries with a discussion of remedial measures.

New York Entomologic Service. Country Gentleman, June 8, 1905, 70:537¹⁵

Summary of reports from voluntary observers.

Go for Cutworms. Country Gentleman, June 8, 1905, 70:540²³

Remedial measures.

Report of the Committee on Entomology. New York State Fruit Growers Association Proc. 4th Ann. Meeting, 1905, p.27-30

Results obtained against the grape root worm, *Fidia viticida* Walsh, and with lime-sulfur washes in controlling San José scale, *Aspidiotus perniciosus* Comst.

San José Scale on the Move. Garden Magazine, July 1905, p.284

Warning notice giving formulas for summer washes for San José scale, *Aspidiotus perniciosus* Comst., and directions for controlling sundry other pests.

Hickory Gall Aphid. Country Gentleman, June 15, 1905, 70:564⁴²

Observations upon and life history of hickory gall aphid, *Phylloxera caryaecaulis* Fitch.

New York Entomologic Service. Country Gentleman, June 15, 1905, 70:561⁴²

Summary of reports.

Grape Root Worm, *Fidia viticida* Walsh. N. Y. State Entomologist, 20th Report. 1905. p.1-19 (issued June 19, 1905). Reprinted in part in Grape Belt (Dunkirk, N. Y.) June 27, 1905, p.7

Account of experiments and investigations during 1904.

Horticulture: Diseases and Pests. N. Y. State Library Bul. 97.
Legislation 25. 1905. p.08-010

General review of legislation for 1904.

Cecropia Moth. Country Gentleman, June 22, 1905, 70:584³²

Brief descriptive account of the cecropia moth, *Samia cecropia* Linn.

New York Entomologic Service. Country Gentleman, June 22, 1905, 70:585¹²; New York Farmer, June 22, 1905, p.5

Summary of reports from voluntary observers.

Perhaps Elm Leaf Beetle. Country Gentleman, June 22, 1905, 70:592²¹

Descriptive account with general remedial measures for elm leaf beetle, *Galerucella luteola* Müll.

Danger in the Use of Sprays. Country Gentleman, June 22, 1905, 70:592²⁶

Careful spraying is not dangerous to fruit consumers when ordinary discretion is employed.

Cherry Aphid. Country Gentleman, June 29, 1905, 70:606²⁵

Brief account of injuries and control measures for cherry aphid, *Myzus cerasus* Fabr.

New York Entomologic Service. Country Gentleman, June 29, 1905, 70:607¹²; New York Farmer, June 29, p.8

Summary of reports from voluntary observers.

Arsenical Poison for Elm Tree Beetles. Dayton (O.) Herald, July 1, 1905, p.4

A summarized account of the elm leaf beetle, *Galerucella luteola* Müll. with special reference to control methods.

May Flies and Midges of New York. N. Y. State Mus. Bul. 86.

Entomology 23. 1905. 352p. 37pl. (issued July 3, 1905)

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New York Entomologic Service. Country Gentleman, July 6, 1905, 70:627³⁴; New York Farmer, July 6, p.5

Summary of reports from voluntary observers.

North American Hydroptilidae. Reprint from N. Y. State Mus. Bul. 86. 1905. p.63-75. 3pl. (issued July 7)

Aquatic Nematoceros Diptera II. Reprint from N. Y. State Mus. Bul. 86. 1905. p.74-327. pl.16-37 (issued July 7)

New York Entomologic Service. Country Gentleman, July 13, 1905, 70:647¹³; New York Farmer, July 13, p.8

Summary of reports from voluntary observers.

Four pests in August. Garden Magazine, Aug. 1905, p.39

Remedies for fall webworm, *Hyphantria textor* Harr., San José scale, *Aspidiotus perniciosus* Comst., stalk borer, *Papaipema nitela* Guen. and ants.

Elm Leaf Beetle. Country Gentleman, July 20, 1905, 70:666²³

Remedial measures for elm leaf beetle, *Galerucella luteola* Müll.

Notes for the Year in New York. U. S. Dep't Agric. Bureau of Ent. Bul. 52. 1905. p.51-52

Brief notices of several injurious species, with special mention of the Chinese lady beetle, *Chilocorus similis* Rossi, and the grape root worm, *Fidia viticida* Walsh.

Experiments with Lime-sulfur Washes. U. S. Dep't Agric. Bureau of Ent. Bul. 52. 1905. p.25-27

General observations on preparation and effects, with an account of the sal soda lime-sulfur wash.

New York Entomologic Service. Country Gentleman, July 20, 1905, 70:666¹³; New York Farmer, July 20, p.4

Summary of reports from voluntary observers.

Spittle Insects or Frog Hoppers. Country Gentleman, July 20, 1905, 70:669¹³

Brief general account of spittle insects, with mention of *Philaenus spumarius* Linn. and *P. lineatus* Linn.

Electric Light or Giant Water Bug. Country Gentleman, July 27, 1905, 70:689²¹

Records injury to $\frac{1}{2}$ pound trout, with notes on habits of electric light or giant water bug, *Belostoma americanum* Leidy.

Woolly Maple-leaf Aphid. Country Gentleman, July 27, 1905, 70:689²⁷

Records unusual abundance of woolly maple-leaf aphids, *Pemphigus acerifolii* Riley, with discussion of remedies.

An Army Worm Outbreak. Country Gentleman, July 27, 1905,
70:694²⁸

Records injuries in Erie and Chautauqua counties and gives a general account of *Helio phila unipuncta* Haw., with discussion of remedial measures.

New York Entomologic Service. New York Farmer, July 27,
1905, p.8

Summary of reports from voluntary observers.

New York Entomologic Service. Country Gentleman, Aug. 3,
1905, 70:707¹²

Summary of reports from voluntary observers.

New York Entomologic Service. New York Farmer, Aug. 3,
1905, p.5

Summary of reports from voluntary observers.

New York Entomologic Service. Country Gentleman, Aug. 10,
1905, 70:726⁴⁶

Summary of reports from voluntary observers.

Trapping Squash Bugs. Country Gentleman, Aug. 17, 1905,
70:747²³

Shingle method of trapping squash bugs, *Anasa tristis* DeGeer.

Experience in Controlling San José Scale in New York. Ct. Pom.
Soc. Proc. 1905, p.132-46

Summarized account of work against the San José scale, *Aspidiotus perniciosus* Comst., with special discussion of lime-sulfur washes.

The Borers are Active. Garden Magazine, Sep. 1905, p.82

Directions for combating borers, specially apple borers, *Saperda candida* Fabr. and the leopard moth, *Zeuzera pyrina* Fabr., are given.

Fighting San José Scale. Country Gentleman, Aug. 24, 1905,
70:774⁴¹

Winter treatment with lime-sulfur washes advised for San José scale *Aspidiotus perniciosus* Comst., though whale oil soap is valuable. The selection of a spraying outfit must be governed by condition.

Plea for the Shade Trees. The Argus [Albany] Sep. 3, 1905, p.3, also in Albany Press & Knickerbocker, Sep. 3; Troy Times, Sep. 5; Cohoes Dispatch, Sep. 5; Utica Observer, Sep. 6; Utica Press, Sep. 4; Rome Sentinel, Sep. 5; Syracuse Post-Standard, Sep. 5; Geneva Times, Sep. 6; Rochester Democrat, Sep. 6; Rochester Post-Express, Sep. 8; Buffalo Commercial, Sep. 9; Buffalo Courier, Sep. 6; Lockport Journal, Sep. 12; Lockport

Union Sun, Sep. 5; New York Herald, Sep. 5; New York Post, Sep. 7; Newburgh Register, Sep. 11; Niagara Falls Gazette, Sep. 30; Rochester Union, Oct. 13

A brief general circular making a plea for the better protection of our shade trees.

Insects Dangerous as Disease Carriers. The Argus [Albany] Sep. 3, 1905, p.11; Amsterdam Recorder, Oct. 10, 1905

Brief résumé of the role of insects as disease carriers with special reference to malaria and yellow fever.

Moth Traps Again. Country Gentleman, Sep. 7, 1905, 70:814-15

Brief comments on the value of trap lanterns for insect control.

Spraying Apples. Country Gentleman, Sep. 14, 1905, 70:838²⁵

Comments on the value of spraying, now considered established beyond question.

Stingless Bees. Country Gentleman, Sep. 21, 1905, 70:870⁴⁵

Comments on the value of these bees in the United States.

Locust Borer. Country Gentleman, Sep. 28, 1905, 70:884²³

Brief descriptive account of the locust borer, *Cyllene robiniae* Forst.

Gnarled Pears. Country Gentleman, Sep. 28, 1905, 70:885²³

Control methods for plant lice and the tarnished plant bug, *Lygus pratensis* Linn. are given as possible remedies for deformed fruit.

Beech Blight. Country Gentleman, Oct. 12, 1905, 70:932⁴⁷

Brief general notice of *Pemphigus tessellata* Fitch with mention of its interesting enemy, *Feniseca tarquinius* Fabr.

SPECIES ACQUIRED THROUGH EXCHANGE

An exchange list was prepared early in 1903 and sent to various entomologists, with the result that a number of valuable additions were made to the State collection. These lists were further elaborated in the report for that year and exchanges have been continued with mutual benefit. The following are lists of species acquired largely in 1905 though a few of the insects were received in 1904.

Mosquitos received in exchange

Grabhamia jamaicensis Theo., adults, pupae and larvae, Prof. Glenn W. Herrick, Agricultural College, Miss.
Theobaldia incidens Thom. and *Culicada curriei* Coq., Prof. V. L. Kellogg, Stanford University, Stanford, Cal.

- Culicada annulifera* Lud., *Mansonia annulifera* Theo., *M. uniformis* Theo. and *Nyssorhynchus fuliginosus* Giles, C. S. Ludlow, Surgeon General's office, Washington, D. C.
- Anopheles* *sp.*, *Culicada squamiger* Coq., *C. curriei* Coq., *Culex tarsalis* Coq. and *Theobaldia incidens* Thom., H. J. Quayle, University of California, Berkeley, Cal.
- Culicada squamiger* Coq., *C. pretans* Gross., *C. punctor* Kirby, *C. dupreei* Coq., *Pneumaculex signifer* Coq., *Protoculex serratus* Theo. and *Wyeomyia smithii* Coq., Dr J. B. Smith, State Entomologist, New Brunswick, N. J.
- Taeniorhynchus aurites* Theo., *Culex fatigans* Wied., and *Pyretophorus costalis* Loew., Dr Andrew Balfour, Director Gordon College Laboratories, Khartoum, Egypt.
- Myzorhynchus sinensis* Wied., *Desvoidea obturbans* Walk., *Culex fatigans* Wied. and Chironomids *sp.* from M. Gist Gee, Soochow, China.
- Culicada cantans* Meig. from Staeger's old collection, through Dr F. Meinert, Zoological Museum, Copenhagen, Denmark.

Other insects received in exchange

- Dendroctonus piceaperda* Hopk., *Scirtes tibialis* Guen., *Cryptorhopalum triste* Lec., *Corticaria deleta* Mann., *Miris affinis* Reut., *Apiomerus crassipes* Fabr., *Cicada canicularis* Harr., *Stictocephala lutea* Wlk., *Empoasca mali* LeB., *Aleyrodes vaporariorum* Westw., *Saissetia hemisphaericum* Targ-Tozz., *Dichromorpha viridis* Scudd., *Arphia sulphurea* Fabr., *A. xanthoptera* Burm., *Scudderia curvicauda* DeG., *Schistocerca rubiginosa* Harr., *S. alutacea* Harr., *Gryllus pennsylvanicus* Burm., *Periplaneta americana* Linn., *Chrysopa oculata* Say, Dr W. E. Britton, State Entomologist, New Haven, Ct.
- Dorytomus mucidus* Say, *Chaetocnema confinis* Cr., *Orthaltica melina* Horn., *Disonycha xanthomelaena* Dalm., *Oedionychus gibbitarsis* Say, *Colaspis praetexta* Say, *Lachnosterna rubiginosa* Lec., *Aphodius inquinatus* Hbst., *Trypherus latipennis* Germ., *Telephorus bilineatus* Say, *Omosita colon* Linn., *Olibrus consimilis* Marsh., *Phalacrus politus* Melsh., *Oxytelus insignitus* Grav., *Laccophilus fasciatus* Aube., *L. proximus* Say, *Anisodactylus terminatus* Say, *A. verticalis* Lec., *A. rusticus* Say, *A. opaculus* Lec., *Selenophorus ellipticus* Dej., *Harpalus herbivagus* Say, *H. caliginosus* Fabr., *Cratacanthus dubius* Beauv., *Zygoneura toxineura* O. S., *Leptocoris trivittatus* Say, *Coriscus punctipes* Reut., *Melanolestes picipes* H. S., *Podisus maculiventris* Say, *Euchistus variolarius* P. B., *Thyanta custator* Fabr., *Tettigonia bifida* Say, *T. hieroglyphica* Say, *Diedrocephala coccinea* Forst., *D. mollipes* Say, *Gypona flavilineata* Fb., *Platymetopius frontalis* VanD., *Deltocephalus inimicus* Say, *Limotettix exitio-*

sus Uhl., *Jassus olitorius* Say, *Stobera tricarinata* Say, **E. S. Tucker**, Lawrence, Kan.

Epicauta cinerea Forst., *Bruchus quadri-maculatus* Fabr., *Adimonia rufosanguinea* Say, *Diabrotica vittata* Fabr., *D. duodecim-punctata* Oliv., *Cerotoma trifurcata* Forst., *Doryphora decim-lineata* Say, *Ligyrrus rugiceps* Lec., *Monocrepidius vespertinus* Fabr., *Phorbia fusiceps* Zett., *Hypoprepia fucosa* Hübn., *Utetheisa bella* Linn., *Oligia grata* Hübn., *Prodenia commelinae* Sm. & Abb., *P. ornithogalli* Guenee *var. B. praeifica* Grt., *Mamestra laudabilis* Guenee, *Heliophila unipuncta* Haw., *H. phragmitidicola* Guenee, *Heliothis armiger* Hübn., *Schinia marginata* Haw., *Alabama argillacea* Hübn., *Drasteria erectea* Cram., *Catocala viduata* Guenee, *Panapoda carneicosta* Guenee, *Homoptera lunata* Drury *var. edusa* Drury, *Epizeuxis lubricalis* Geyer, *Sanninoidea exitiosa* Say, *Murgantia histrionica* Hahn., *Leptoglossus phyllopus* Linn., *Chrysomphalus tenebricosus* Comst., *C. obscurus* Comst., *Aspidiotus forbesi* John, **Prof. Glenn W. Herrick**, Agricultural College, Miss.

Acrolophitus hirtipes Say., *Amphitornus bicolor* Thom., *Cordillacris crenulata* Brun., *C. occipitalis* Thom., *Phlibostroma quadrimaculatum* Thom., *Chloealtis abdominalis* Thom., *Platybothrus brunneus* Thom., *Gomphocerus clepsydra* Scudd., *Stirapleura decussata* Scudd., *Ageneotettix scudderi* Brun., *Aulocara elliotti* Thom., *A. femoratum* Scudd., *Arphia tenebrosa* Scudd., *A. teporata* Scudd., *Chorthaga viridifasciata* DeG., *Hippiscus neglectus* Thom., *H. pardalinus* Sauss., *Metator maculosum* Sauss., *Dissosteira carolina* Linn., *Spharagemon aequale* Say., *S. collare* Scudd., *Derotymema haydeni* Thom., *Mestobregma kiowa* Thom., *M. pulchellum*, *Trimerotropis azurea* Brun., *T. juliana* Scudd., *T. plattei* Thom., *T. monticola* Sauss., *T. suffusa* Scudd., *Circotettix lapidicola* Brun., *C. undulatus* Thom., *Hadrotettix trifasciatus* Say., *Aeoloplus turnbulli* Brun., *Melanoplus affinis* Brun., *M. alpinus* Brun., *M. altitudinum* Scudd., *M. bruneri* Scudd., *M. dawsoni* Scudd., *M. fasciatus* Parnst., *M. flabellifer* Scudd., *M. fluviatilis* Brun., *M. gladstoni* Brun., *M. infantilis* Scudd., *M. minor* Scudd., *M. packardi* Scudd., *Asemoplus montanus* Brun., **Prof. R. A. Cooley**, State Entomologist, Bozeman, Mon.

Elaphrus riparius Oliv., *Carabus genei* Gene., *Percus reichei* Fairm., *Haliphus lineatocollis* Marsh., *Bidessus geminus* Fabr., *Deronectes opatrinus* Germ., *Hydroporus griseostriatus* DeG., *H. lepidus* Oliv., *H. analis* Aube., *Gyrinus urinator* Ill., *Hister major* Linn., *H. quadri-maculatus* Linn., *H. sinuatus* Fabr., *Saprinus semipunctatus* Fabr., *S. nitidulus* Payk., *S. dimidiatus* Ill., *Lucanus servus* Linn., *Scarabeus sacer* Linn., *S. lati-*

collis Linn., *Copris hispanus* Linn., *Potosia metallica* Payk., *Lixus iridis* Oliv., *L. algirus* Linn., *L. cardui* Oliv., *Brachytemus porcatus* Germ., *Balaninus turbatus* Gyll. *Leptura rubra* Linn., *L. maculata* Poda., *Morimus asper* Sulz., *Colaspidea oblonga* Blanch., *Chrysomela polita* Linn., *Galerucella luteola* Müll., *Podagrica discedens* Boield., *Hispa atra* Linn., *Lema melanopus* Linn., *Diplognatha gagates*, *Onthophagus trituber*, *Hymantocera plumosa*, *Sternotomis regalis*, *S. imperialis*, *Pyllvenima latipes* DeG., *Prionocerus coevulipennis*, *Bruchus bimaculatus* Oliv., *Cryptorhynchus frigidus*, *Sphenophorus sordidus*, **G. VanRoon**, Rotterdam, Holland.

Poecilus cupreus Linn., *Amara atrata* Heer., *Harpalus aeneus* Fabr., *Metabletus pallipes* Dej., *Par dileus calceatus*, *Laccophilus obscurus* Panz., *Coelambus impressopunctatus* Schall., *Bidessus geminus* Fabr., *Cymatopterus fuscus* Linn., *Cybister laterimarginalis* Deg., *Hydrous piceus* Linn., *Limnoxenus oblongus* Herbst., *Cercyon quisquilius* Linn., *Heterocerus laevigatus* Panz., *Paederus fuscipes* Curt., *Oxytelus laqueatus* Marsh., *O. tetracaratus* Block., *Anthobium sorbi* Letzn., *Bryaxis haematica* Reichb., *Silpha obscura* Linn., *Hister quadrinotatus* Scriba., *Copris lunaris* Linn., *Onthophagus ovatus* Linn., *Aphodius fimetarius* Linn., *Geotrupes mutator* Marsh., *G. sylvaticus* Panz., *G. vernalis* Linn., *Serica holosericea* Scop., *Anomala vitis* Fabr., *Epicometis hirta* Poda., *Agriotes sputator* Rdtb., *Plagionotus arcuatus* Linn., *Otiorhynchus gemmatus* Scop., *Baris lepidii* Germ., *Chrysomela sanguinolenta* Linn., *Subcoccinella vigintiquattuor punctata* Linn., **Robert Meusel**, Ujpest, Hungary.

CONTRIBUTIONS TO COLLECTION OCT. 17, 1904-OCT.

14, 1905

Hymenoptera

Tremex columba Linn., pigeon Tremex, larvae in beech, Ap. 20, **George S. Graves**, Newport, N. Y.

Pontania hyalina Nort., galls on willow, July 18, **Paul Hayhurst**, Dunkirk, N. Y.

Lophyrus abbotii Leach, Abbott's pine sawfly, larvae on pine, Sep. 6, **C. R. Pettis**, Saranac Inn, N. Y.

Coleoptera

Mardarellus undulatus Say, Mar. 11, **L. H. Joutel**, New York city.

Calandra oryzae Linn., adult on corn, Jan. 9, **Thomas Cunningham**, Victoria, B. C.

Bruchus rufimanus Sch., European bean weevil, adult on bean, Jan. 13, **Paul Hayhurst**, Columbia, Mo. (In beans presumably from Italy)

Cyllene robiniae Forst., locust borer, adult on honey locust, Sep. 25, **L. G. V. McDonough**, Newcastle co. Del. (Through Country Gentleman)

Plagionotus speciosus Say, sugar maple borer, adult, July 1, **Frederick Pfahl**, Albany, N. Y.

Uliota dubius Fabr., Ap. 5, **J. T. Brakeley**, Hornerstown, N. J.

Dytiscus harrisii Kirby, margined water beetle, May 19, **J. D. Collins**, Utica, N. Y.

A number of undetermined South African species were kindly donated to the collection by **Ogden Stevens**, Albany.

Diptera

Rhagoletis pomonella Walsh, apple maggot, maggots in apple, Aug. 8, **C. H. Stuart**, Newark, N. Y.

Oedaspis polita Loew., adult on *Solidago juncea*, Sep. 1, **Miss Harriet B. Badeau**, Matteawan, N. Y.

Straussia longipennis Wied. on pepper, May 14, **George S. Graves**, Newport, N. Y.

Pollenia rudis Fabr., Oct. 3, **M. R. Wilbur**, Old Chatham, N. Y.

Bombyliomyia abrupta Wied., parasite fly, July 22, **Hamilton B. Brown**, Elmira, N. Y.

Deromyia umbrinus Lowe, robber fly, adult, July 31, **O. Q. Flint**, Athens, N. Y.

Cecidomyia antennaria Wheeler, galls on *Antennaria plantaginifolia*, Sep. 10, **S. H. Burnham**, Little Falls, N. Y.

Dasyneura pseudacaciae Fitch, black-locust midge galls on black-locust, June 10, **C. L. Williams**, Glens Falls, N. Y.

Cecidomyia sp., galls on *Eupatorium ageratoides*, Sep. 10, **S. H. Burnham**, Little Falls, N. Y.

Lasioptera vitis O. S., grape tomato gall, Aug. 4, **H. A. Van Fredenberg**, Port Jervis, N. Y.

Anopheles franciscanus McCracken, Dec. 20, **H. G. Dyar**, Washington, D. C.

Anopheles maculipennis Meig., adult, Jan. 10, **Henry Clay Weeks**, Ithaca, N. Y.

Cyclolepteron grabhamii Theo., male and female, larvae, Mar. 29, and adult, Sep. 18, **M. Grabham**, Kingston, Jamaica, W. I.

Cellia albipes Theo., males, females and larvae, Mar. 29, **M. Grabham**, Kingston, Jamaica, W. I.

Janthinosoma musicum Say, Dec. 20, **H. G. Dyar**, Washington, D. C.

Grabhamia jamaicensis Theo., adult, Sep. 18, **M. Grabham**, Kingston, Jamaica, W. I.

Grabhamia pygmaea Theo., adult, Sep. 18, **M. Grabham**, Kingston, Jamaica, W. I.

Culicelsa taeniorhynchus Wied., females and larvae, Mar. 29, **M. Grabham**, Kingston, Jamaica, W. I. Same, adult, Sep. 18, **M. Grabham**, Kingston, Jamaica, W. I.

Culicada canadensis Theo., young larvae, Mar. 31, J. T. Brakeley, Hornerstown, N. J. Same, larvae, Ap. 17, W. T. Davis, Staten Island, N. Y.

Culicada curriei Coq., Dec. 20, H. G. Dyar, Washington, D. C.

C. varipalpus Coq., Dec. 20, H. G. Dyar, Washington, D. C.

C. pretans Grossbeak, adults, Jan. 9, W. E. Britton, New Haven, Ct.

C. triseriatus Say, very young larvae from a tree hole, Ap. 18, F. E. Lutz, Cold Spring Harbor, L. I.

C. pullatus Coq., Dec. 20, H. G. Dyar, Washington, D. C.

C. abserratus Felt & Young, adult, Jan. 9, W. E. Britton, New Haven, Ct.

Culicella melanurus Coq., larva, Mar. 31, J. T. Brakeley, Hornerstown, N. J.

Culex fatigans Wied., adults, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

C. restuans Theo., July 27, C. R. Pettis, Lake Clear, N. Y.

C. tarsalis Coq., Dec. 20, H. G. Dyar, Washington, D. C.

C. confirmatus Arri., males and females, Mar. 29, M. Grabham, Kingston, Jamaica, W. I.

C. janitor Theo., adult, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

C. secutor Theo., Dec. 20, H. G. Dyar, Washington, D. C. Same, adults, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

C. microsquamatus Theo., adults and larvae, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

Melanoconion atratus Theo., males, females and larvae, Mar. 29, M. Grabham, Kingston, Jamaica, W. I.

Taeniorhynchus perturbans Walk., adult, Jan. 9, W. E. Britton, New Haven, Ct.

Stegomyia fasciata Fabr., Dec. 20, H. G. Dyar, Washington, D. C. Same, June 13, Arthur I. Kendall, Panama.

Pneumaculex signifer Coq., adults, Jan. 2, Nathan Banks, Washington, D. C. Same, Dec. 20, H. G. Dyar, Washington, D. C.

Deinocerites cancer Theo., Dec. 20, H. G. Dyar, Washington, D. C. Same, females and larvae, Mar. 29, M. Grabham, Kingston, Jamaica, W. I.

Uranotaenia lowii Theo., adults and larvae, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

U. socialis Theo., males, females and larvae, Mar. 29, M. Grabham, Kingston, Jamaica, W. I.

Wyeomyia smithii Coq., larvae, Mar. 31, J. T. Brakeley, Hornerstown, N. J. (Abundant sending Ap. 2). Same, June 27, George E. Casler, Haymarsh. (Haymarsh is $\frac{1}{2}$ mile east of Crooked Pond)

Dendromyia mitchellii Theo., adults, Sep. 18, M. Grabham, Kingston, Jamaica, W. I.

Howardina walkeri Theo., female and larvae, Mar. 29, M. Grabham, Kingston, Jamaica, W. I. Same, Dec. 20, H. G. Dyar, Washington, D. C.

Megarhinus portoricensis Roeder, Dec. 20, H. G. Dyar, Washington, D. C.

Corethrella brakeleyi Coq., larvae, Mar. 31, **J. T. Brakeley**, Hornerstown, N. J.

Tipula abdominalis Say, larvae, Ap. 24, **J. T. Brakeley**, Hornerstown, N. J.

Lepidoptera

Noctua clandistina Harr., W-marked cutworm on pine, May 15, **C. R. Pettis**, Saranac Junction, N. Y.

Papaipema nitela Guen., stalk borer on tomatoes and scarlet runner beans, June 20, **H. B. Chown**, Falls Village, Ct.

Drasteria erechtea Cramer, clover semilooper caterpillar, Aug. 12, **James E. Barkley**, Grahamsville, N. Y.

Melalopha inclusa Hübn., poplar nest worm, larvae on cottonwood, Sep. 15, **Dr M. W. VanDenburg**, Mt Vernon, N. Y.

Symmerista albifrons Sm. & Abb., red-headed oak worm, larvae on maple, Sep. 14, **C. E. Eldridge**, Leon, N. Y.

Hemerocampa leucostigma Sm. & Abb., white marked tussock moth, larvae, July 8, **L. L. Woodford**, Pompey, N. Y. Same, half grown caterpillar, July 15, **F. E. Fitch**, Randolph, N. Y. Same, young, cocoon and egg mass, Aug. 7, **Dr M. W. VanDenburg**, Mt Vernon, N. Y.

Thyridopterix ephemeraeformis Haw., bag worm, cocoons on *Arbor vitae*, Jan. 16, **Hermann VonSchrenck**, St Louis, Mo. Same, on purple beech, July 31, **Joseph H. Dodge**, New York.

Sibine stimulea Clem., saddle back caterpillar, larva on corn, Sep. 6, **Frank R. Calkins**, Ossining, N. Y.

Phobetron pithecium Sm. & Abb., hag moth, larva on bitter sweet, Sep. 5, **Miss M. R. Wilbur**, Old Chatham, N. Y.

Lithacodes fasciola Herrick & Schafer, larva, Aug. 3, **G. S. Graves**, Newport, N. Y.

Memythrus polistiformis Harr., larvae on grape, Nov. 30, **Mrs A. Rogers**, Hyde Park, N. Y. (Through **Thomas P. Connor**, gardener)

Enarmonia prunivora ? Walsh., larvae on apple, Feb. 5, **T. Cunningham**, Vancouver, B. C.

Ecdytolopha insiticiiana Zell., locust twig gall on locust, Sep. 27, **Dr Frank Overton**, Patchogue, N. Y.

Anarsia lineatella Zell., work on cherry, Oct. 5, **P. L. Husted**, Blauvelt, N. Y.

Nepticula castaneaefoliella ? Chamb. on chestnut, Aug. 23, **R. H. Johnson**, Cold Spring Harbor, L. I.

Tischeria malifoliella Clem., apple leaf miner, larva on apple, Sep. 11, **T. F. Niles**, Lockport, N. Y. (Through N. Y. State Dep't Agric.)

Hemiptera

Clastoptera proteus Fitch, spittle insect, young on *Cornus*, June 28, **George T. Powell**, Ghent, N. Y.

Ptyelus ? *lineatus* Linn., spittle insect, nymph and adult on grass, June 20, **J. P. VanNess**, East Greenbush, N. Y.

Cicada sp., Jan. 6, **George D. Miller**, China.

Belostoma americanum Leidy, giant water bug on trout, adult, July 5, **E. J. Casler**, Hoffmeister, Hamilton co., N. Y. Same, Sep. 19, **H. H. DeyErmand**, Albany, N. Y.

Phylloxera caryaecaulis Fitch, hickory gall aphid, galls and young on hickory, June 5, **Dr J. B. Southworth**, Nassau, N. Y.

P. vitifoliae Fitch, grape *Phylloxera* on grape, July 21, **Dr J. B. Southworth**, Nassau, N. Y.

Pemphigus acerifolii Riley, woolly maple leaf aphid, adult on maple, June 28, **Mrs D. H. Bayard**, Cornwall on the Hudson, N. Y. Same, on soft maple foliage, July 3, **Prof. C. H. Peck**, Menands, N. Y.

P. imbricator Fitch, beech blight, nymphs and adults on beech, Sep. 9, **F. M. Foote**, Chester, Mass. (Through *Country Gentleman*).

P. rhois Fitch, sumac gall, adult on sumac, Sep. 10, **S. H. Burnham**, Little Falls, N. Y.

P. ulmifusus Walsh, spindle-shaped elm gall, on cork or rock elm, July 6, **C. L. Williams**, Glens Falls, N. Y.

Lachnus smilacis Will., on smilax, July 24, **George S. Graves**, Newport, N. Y.

Callipterus betulaecolens, birch aphid on birch, June 20, **C. H. Stuart**, Newark, N. Y.

Chrysomphalus smilacis Comst., on smilax, Mar. 30, **E. B. Southwick**, New York.

C. tenebricosus Comst., gloomy scale on hackberry, May 15, **Mrs P. L. Windsor**, Austin, Tex.

Eulecanium nigrofasciatum Perg., black-banded scale on maple, Ap. 6, **E. B. Southwick**, New York.

Phenacoccus acericola King, maple *Phenacoccus* on maple, Aug. 12, **R. A. Kenworthy**, Poughkeepsie, N. Y. Same, on maple, Aug. 15, **C. F. Polk**, Troy, N. Y.

Eriopeltis coloradensis Ckll. on grass, Dec. 19, **Theo. D. A. Cockerell**, Boulder, Col.

Eulecanium quercifex Fitch, on chestnut, June 2, **Eliza S. Blunt**, New Russia, N. Y.

Tachardia glomerella Ckll. on gutienesia, Dec. 19, **Theo. D. A. Cockerell**, Mesilla valley, N. M.

The following species of Hemiptera were received from **Mr J. R. de la Torre Bueno**, who collected them in the vicinity of New York city. The determinations were kindly made by Mr E. P. VanDuzee of Buffalo, and Mr O. Heidemann, through the courtesy of Dr L. O. Howard of Washington: *Lopidea media* Say, *Neurocolpus nubilus* Say, *Phytocoris pallidicornis* Reut., *P. eximus* Reut., *Stiphrosoma stygica* Say, *Poecilocapsus affinis* Reut., *P. goniphorus* Say, *Systratiotus venaticus* Uhl., *Orthops scutellatus* Uhl., *Plagiognathus obscurus* Uhl., *P. politus* Uhl., *Chlamydatus (Agalliastes) verbasci* H.S., *Episcopus ornatus* Reut., *Deraeocoris segusinus* Muell., *Onychumenus decolor* Fall., *Agalliastes associatus* Uhl., *A. suavis* Reut., *Diommatus congreg* Uhl., *Stenotus (Oncognathus) binotatus* Fabr., *Orthometrops decorata* and *Salda ligata* Say.

Orthoptera

Gryllotalpa borealis Burm., mole cricket, adult, Aug. 15, **Hugh H. DeyErmand**, Albany, N. Y.

Aracnida

Tetranychus telarius Linn., red spider on apple, July 27, William H. Hart, Poughkeepsie, N. Y. Same, on elm, Aug. 4, F. J. H. Kracke, New York.

Eriophyes fraxiniflora ash flower gall on ash, June 24, H. G. Pauli, Brooklyn, N. Y.

EXPLANATION OF PLATES

PLATE I

Row of soft maples badly injured by the leopard moth, *Zeuzera py-*
rina Fabr. Astoria, L. I., 1900

Plate 1

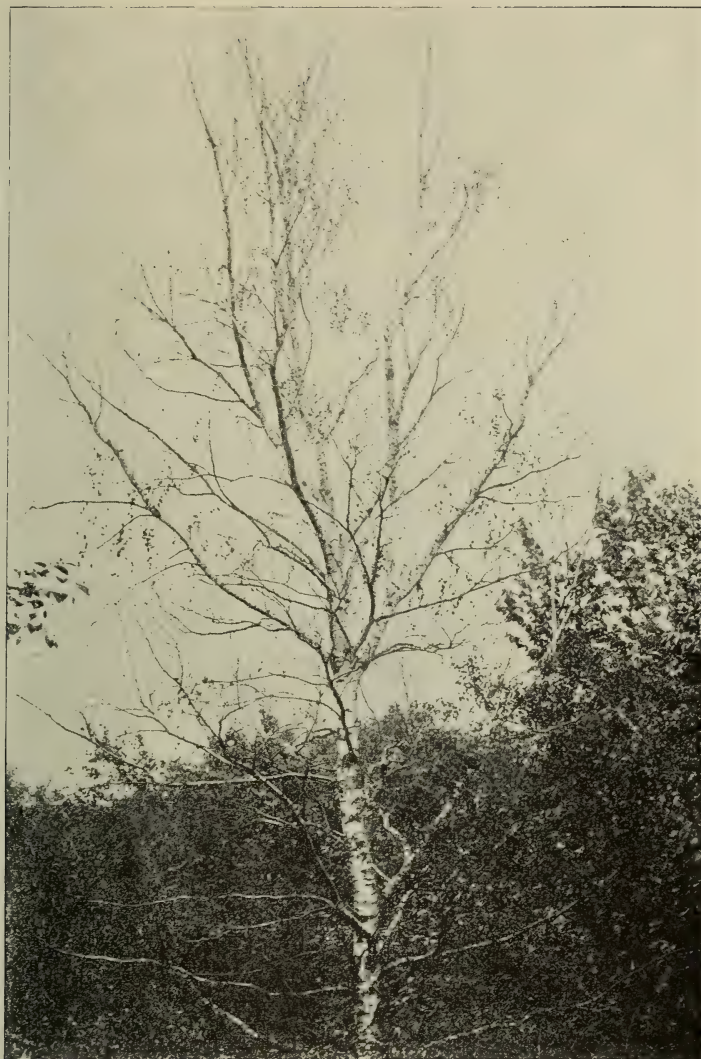


Work of leopard moth

PLATE 2

White birch killed by bronzed birch borer, *Agrilus anxius* Gory.
Photograph by M. F. Adams

Plate 2



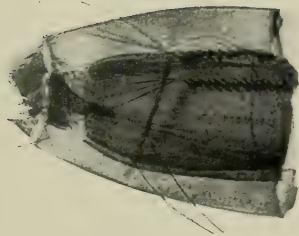
Work of bronze birch borer

PLATE 3

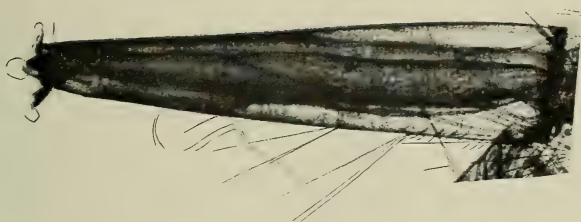
Air tubes of Culicid larvae

- 1 Air tube of larva of yellow fever mosquito, *Stegomyia fasciata*
Fabr. x55
- 2 Air tube of larva of house or rain barrel mosquito, *Culex pipiens*
Linn. x55
- 3 Air tube of larva of salt marsh mosquito, *Culex sollicitans*
Walk. x45

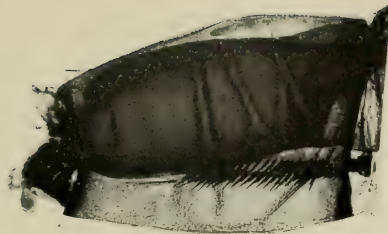
Plate 3



1



2



3

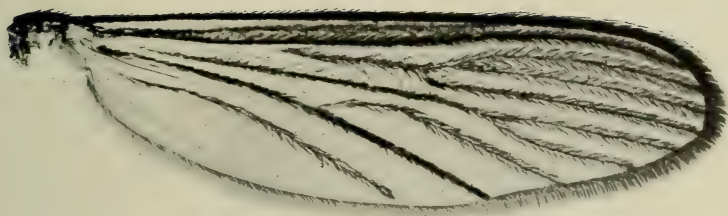
Air tubes of mosquito larvae

PLATE 4

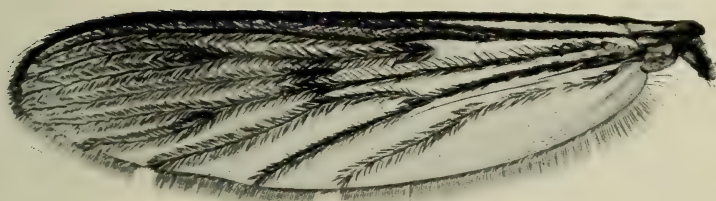
Culicid wings

- 1 Female wing of house or rain barrel mosquito, *Culex pipiens*
Linn. x21
- 2 Female wing of malarial mosquito, *Anopheles maculipennis*
Meig. x21
- 3 Female wing of yellow fever mosquito, *Stegomyia fasciata*
Fabr. x21

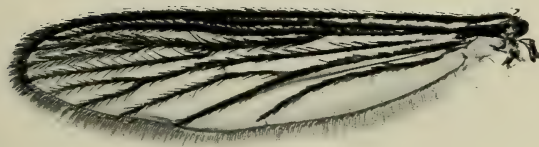
Plate 4



1



2



3

Wings of mosquitos

PLATE 5

- 1 Washtubs under rain spout, containing numerous mosquito larvae
- 2 A spring-fed, easily drained, roadside pool producing hundreds of malarial mosquitos

Plate 5



I



2

Breeding places of mosquitos

PLATE 6

- 1 Recently excavated spring pool swarming with wrigglers of malarial and other mosquitos, though before digging Culicid larvae were rare
- 2 An Adirondack beaver meadow, the home of the pitcher plant mosquito, *Wyeomyia smithii* Coq.

Plate 6



I



2

Breeding places of mosquitos

PLATE 7

- 1 Several pitcher plants in which *Wyeomyia* breeds
- 2 An Adirondack woodland road which fairly swarms with mosquitos during warm weather

Plate 7



I



2

Breeding places of mosquitos



PLATE 8

- 1 An Adirondack stream haunted by thousands of mosquitos
- 2 A new ditch being excavated on salt marshes near Lawrence, L. I., showing perpendicular sides and level bottom.

Plate 8



I



2

Mosquito haunts: ditching salt marsh

PLATE 9

- 1 Recent salt marsh ditches near Lawrence, L. I., partly filled with the tide
- 2 A salt marsh ditch at Lawrence, L. I., dug four years ago, showing grass hanging over and in places meeting, otherwise the ditch is in excellent shape

Plate 9



I



2

Salt marsh ditches

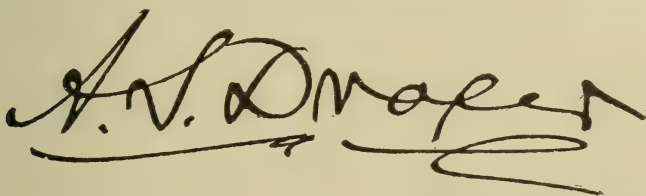
*New York State Education Department
Science Division, February 16, 1906*

*Hon. Andrew S. Draper LL.D.
Commissioner of Education*

SIR: I beg to transmit herewith, for publication as a bulletin of the State Museum, the annual report of the State Entomologist for the year 1905.

Very respectfully
JOHN M. CLARKE
Director

Approved for publication February 17, 1906

A large, stylized handwritten signature in dark ink, reading "A. S. Draper". The signature is written in a cursive style with a long horizontal flourish at the bottom.

Commissioner of Education

New York State Education Department

New York State Museum

JOHN M. CLARKE Director

EPHRAIM PORTER FELT State Entomologist

Bulletin 104

ENTOMOLOGY 26

21st REPORT OF THE STATE ENTOMOLOGIST

1905

To John M. Clarke, Director of Science Division

I have the honor of presenting herewith my report on the injurious and other insects of the State of New York for the year ending October 14, 1905.

General entomologic features. The season of 1905 was marked by the appearance of two destructive grass pests. Grass webworms (*Crambidae*) were very abundant and somewhat injurious to grass lands in Rensselaer and Albany counties in early spring, and in midsummer the army worm, *Heliophila unipuncta* Haw., aroused considerable anxiety by appearing in numbers in limited portions of Chautauqua and Erie counties. Fortunately this latter attack was not extensive and the injury did not approximate that inflicted by this species in 1896. The second brood of the codling moth, *Carpocapsa pomonella* Linn., was unusually abundant and caused serious losses, because the fruit crop was light and prices for first quality fruit correspondingly high. The rose beetle, *Macrodactylus subspinosus* Fabr., was very abundant and injurious in some sections of the State, appearing in swarms and nearly defoliating many fruit trees. The San José scale, *Aspidiotus perniciosus* Comst., continues to spread in fruit-growing sections though it has not been so prolific as last year. Shade trees in some of the principal cities of the State were seriously injured by caterpillars of the white marked tussock moth, *Hemerocampa leucostigma* Abb. & Sm., the pests being so numerous as to defoliate thousands of trees.

San José scale. The control of this destructive insect is still a problem of considerable importance to the horticulturist. The experiments with various insecticides against this species were continued in 1905 and our recent results confirmed in a very gratifying manner. The lime-sulfur wash is fully as effective as any other material which has been employed against this insect in the East, and it is a pleasure to state that our earlier studies in the method of preparing this wash have been fruitful of good results, since experience shows that the prolonged boiling originally insisted upon is unnecessary. We have also demonstrated the possibility of making a reliable wash with lime and sulfur by employing only a little hot water together with a small amount of sal soda, a substance that is both cheap and easily obtained. This preparation is particularly valuable where but a few trees are to be treated.

Grape root worm. This pernicious enemy of the vineyardist is generally distributed throughout the Chautauqua grape region and has been under observation during 1905 for the purpose of corroborating in a general way the results of our earlier studies given in Museum bulletins 59 and 72, special attention being paid to the danger of its suddenly invading a vineyard in immense numbers and inflicting serious injury. Certain vineyards were severely damaged in earlier years and these have been carefully watched for the purpose of obtaining accurate data as to the practicability of restoring them. This can undoubtedly be done to advantage where there is serious injury of but one year's standing provided relief measures are prompt, though it is doubtful whether this is true where hosts of grubs are allowed to work two seasons in succession.

Gipsy and brown tail moths. These two imported insects have become well established in Massachusetts. The gipsy moth is now well known as an extremely voracious enemy of fruit and forest trees. Its spread is slow, as this species, on account of the female's inability to fly, must rely very largely for dissemination upon the eggs or caterpillars being carried from place to place by the movement of animals and the usual means of transportation, by such vehicles as automobiles, electric and steam cars, etc. In spite of this, there is grave danger of its being brought into New York State at almost any time. The brown tail moth, a more recent introduction, flies readily and has already made its way to the Connecticut valley. Like its associate, it is a greedy leaf feeder, living by preference upon our more valuable fruit trees and at the

same time displaying a fondness for the foliage of such shade trees as maples and elms. These two insects are so destructive that a close watch has been kept upon developments in the infested territory so that our citizens may not be taken unawares. In addition, a comprehensive bulletin giving illustrated accounts of these two insects has been prepared.

Shade and forest tree insects. This constitutes an exceedingly important group, particularly as insect depredations on shade trees appear to increase in severity from year to year, strikingly illustrated by the extensive injuries inflicted by tussock moth larvae on the shade trees of many of our cities and villages in 1905. So many trees were defoliated by the pest that the Entomologist judged it timely to make an appeal for their more adequate protection. Good shade trees are surely worth \$10 each. Our estimates show that the total value of these trees in the cities and villages of the State is at least \$18,000,000 and probably much more. It is a short-sighted policy that allows this vast wealth which can be replaced only by great expenditure of both time and money to be destroyed for the want of a little protection, and we have therefore deemed it fitting to urge through the public press that every city of 50,000 or more should make provision for the adequate care of its shade trees by putting them under the control of a properly qualified forester or entomologist connected with either the park or city departments. We have further suggested that most villages would find it advantageous to make some provision for the welfare of their shade trees.

The investigations of shade and forest tree insects, begun by the writer in 1895, have been continued in connection with the extended memoir on *Insects Affecting Park and Woodland Trees*, soon to appear. A series of illustrations necessary for the identification of the very destructive bark borers was an outcome of these studies, a unique feature of the work being the demonstration of specific morphologic differences existing in the proventriculi of these small, dull colored apparently similar forms. Another result of our investigations has been the rearing of a number of gall gnats, known previously only by the vegetable malformations produced. These forms have been characterized in the adult and immature stages and form an excellent basis for further studies of this exceedingly interesting group.

Mosquitos. This group is extremely important economically and very interesting morphologically. Our work has been largely

of a fundamental character, since it is absolutely necessary to define species before any precise statements can be made as to their life history and habits. Several allied forms have been carefully studied in all stages and satisfactory diagnostic characters worked out. Morphologic studies are very important because they reveal natural relationships, something of considerable moment when studying disease-bearing forms, since it is well recognized that closely allied species are very likely to have similar habits. The efficiency of ordinary repressive work also depends largely on a correct knowledge of the species involved. It was extremely difficult to identify either larvae or adults of our native forms previous to the appearance of Museum bulletin 79, a work which contains a series of illustrations very nearly essential to their identification. A material addition to our knowledge of these insects is given in Museum bulletin 97, which contains a revised key for the separation of a large proportion of American Culicid larvae and is of special interest because of the morphologic study of the terminal abdominal appendages, particularly those of the male. We have succeeded in homologizing these structures, have bestowed thereupon a set of appropriate names and our studies have demonstrated that these organs are of great importance to the systematist. Careful morphologic studies have already been made of a number of exotic forms, new material is constantly being received and we should soon be in position to make another important addition to the study of this group. Mr J. R. Gillett, a medical student, has been employed for six months in rearing mosquitos and making microscopic preparations. Some idea of the character and extent of our work may be gained from the following statistics: The State collection of Culicidae now comprises about 4600 pinned specimens, many of them bred, over 1600 microscopic preparations and numerous vials containing alcoholic specimens of larvae, a total of nearly 140 species being represented in the adult or larval stages, many of them in both. It is proposed eventually to bring together the results of our biologic and morphologic studies in a thoroughly comprehensive treatise on the mosquitos of New York State.

Aquatic insects. Dr James G. Needham and Cornelius Betten spent the summer in investigating the aquatic insect fauna of Old Forge and its immediate vicinity. This work resulted in large additions to the State collections, particularly in the Syrphidae and Caddis flies. Dr Needham is now engaged on a monographic account of the stone flies (Plecoptera) of New York State, which

should be completed by the end of the calendar year. Mr Betten has in preparation a comprehensive account of our Caddis flies (Trichoptera), which may be expected in 1907.

The investigation of this hitherto much neglected group was planned on comprehensive lines though its extent was necessarily restricted because of the limited funds available for the purpose. The work already accomplished or in hand constitutes an unrivaled basis for more extended studies, which should not only result in large acquisitions of original knowledge but should also prove of immense service to the fish culturist. An idea of the possibilities may be obtained from the following statistics culled from related lines of effort: A number of years ago the shellfish industry of this State was at a very low ebb and now, as a result of the application of scientific methods, the products amount to over two million (\$2,309,758) dollars. The fresh-water fish products of the Hudson valley and Long Island amounted in 1900 to over one million (\$1,192,544) dollars and that coming into the State from the Great Lakes in 1901 to nearly one fourth million dollars (\$241,916). These returns were obtained with very little or no effort toward improving the available amount of fish food, and there seems to be no reason why our numerous fresh-water lakes, ponds and streams can not be made much more productive. The mere stocking with valuable fish is not sufficient, provision must be made for an adequate food supply. It is very probable that careful studies of water insects and the conditions necessary to their existence would result in ascertaining practical means whereby the amount of available fish food might be immensely increased and the productivity of waters correspondingly influenced. The possible results from further investigations are sufficiently promising to warrant continuing this work so far as available funds will permit.

Publications. The Entomologist has made numerous contributions of a practical nature to the agricultural press. Two important bulletins, entitled *Mosquitos or Culicidae of New York State*, Entomology 22 [N. Y. State Mus. Bul. 79] and *May Flies and Midges of New York*, Entomology 23 [N. Y. State Mus. Bul. 86], have been issued. Owing to unexpected delays, the report of the State Entomologist for 1904 was not issued till after the close of the official year. The stone flies (Plecoptera) of New York State are being monographed by Dr James G. Needham. This work should be completed by the end of the calendar year. The memoir on

Insects Affecting Park and Woodland Trees is going through the press and should appear early in 1906.

Collections. Large and exceedingly valuable additions have been made to the State collection during the past season. The total is about 15,000 pinned specimens besides a great amount of very desirable biologic material. Messrs Needham and Betten secured a large number of valuable specimens at Old Forge, and their work was admirably supplemented by Assistant Entomologist Young, who spent a month collecting in the Adirondacks, specializing in the Hymenoptera and Diptera. Collections have been further enriched by Mr Young's donating some 3000 Coleoptera, many of them rare and a considerable proportion new to the State collection. The general condition of the collection has been much improved during the year. Mr Young has devoted a large share of his time to classifying the Hymenoptera and Diptera, while assistant Nixon has given most of his attention to the Coleoptera.

Office work. The general work of the office has been conducted about as in preceding years, aside from somewhat serious interruptions due to the protracted sickness of Assistant I. L. Nixon and a shorter illness of Assistant Entomologist D. B. Young. Continued and gratifying interest in our work is indicated by the correspondence. 2035 letters, 784 postals, 490 circulars and 1109 packages were sent through the mails, and 439 packages were shipped by express.

Nursery certificates. Indorsing of nursery certificates issued by the State Commissioner of Agriculture has been continued as formerly whenever the same was requested, which has been the uniform practice of the Virginia authorities for several years. The following is a list of firms to whom these nursery certificates were issued in the summer and fall of 1905: Nelson Bogue, Batavia; George W. Whitney & Co., Bryart Bros., George A. Sweet, Morey & Son, Stark Bros., Rogers Nurseries and Sheerins Wholesale Nurseries, all of Dansville; T. S. Hubbard & Co., George S. Josselyn, Wheeler & Clark, L. Roesch, Foster & Griffith and T. E. Schifferli, all of Fredonia; W. & T. Smith, R. G. Chase Co. and Sears, Henry & Co., all of Geneva; E. A. Barnes, Middle Hope; Mrs L. S. Peterson, Montrose; Jackson & Perkins Co., Newark; Eugene Willett, North Collins; M. F. Tiger, Patchogue; Stark Bros., Portland; Chase Bros. Co., Irving Rouse, Hawk Nursery Co., T. W. Bowman & Son Nursery Co., Perry Nursery Co., Ellwanger & Barry, Western N. Y. Nursery Co. and Brown Bros. Co., all of Rochester; Lake View Nursery Co., Sheridan.

Voluntary observers. The voluntary observers have continued to send reports throughout the growing season and a number of valuable facts were brought to our notice in this way. These reports, with the advance of years, will constitute a unique record of the abundance and destructiveness of various pests in New York State, which should prove of great service to all those interested in securing data on insect outbreaks and causes controlling the same.

Historical. It is 50 years since the first report on injurious and beneficial insects was published by Dr Asa Fitch, then entomologist to the State Agricultural Society and practically State Entomologist. This document, unique as the first report on injurious insects in this country by a salaried State official, was the precursor of a magnificent series, 14 in all, consisting of over 1100 pages of largely original matter. These publications deal with insects affecting the agriculturist, special attention being paid to those depredating on grain and garden crops, fruit and forest trees, and constitute invaluable records to which economic entomologists must frequently refer. A decade elapsed between the appearance of the last report prepared by Dr Fitch and the first written by Dr Joseph A. Lintner, State Entomologist, though the latter published a number of practical entomologic articles and did considerable work along economic lines during this period.

Dr Lintner was first appointed State Entomologist in 1880, and the quarter century since elapsing has been very prolific. During his term of office he prepared 13 important reports beside several minor ones and contributed over 900 independent articles to the agricultural and horticultural press. His studies and investigations were devoted chiefly to insects of prime economic importance, such grass pests as the army worm receiving careful attention, while species depredating on fruit and forest trees were by no means neglected. His official publications, extending over a period of 18 years, comprise a very valuable addition to economic literature and rank high in the estimation of all practical entomologists.

Later work of the office has been greatly facilitated by that done in previous years, the earlier records and collections proving exceedingly valuable. Large collections, particularly along special lines, have been characteristic of this recent work. Important exhibits of injurious insects have been prepared and maintained and interesting collections sent to the large expositions held at Buffalo, N. Y. and St Louis, Mo., all aiding in bringing the work of the

office to public notice. The more destructive insects have received attention from year to year, and in addition a serious attempt has been made to conduct special investigations with the idea of making more valuable additions to our knowledge of injurious species.

The San José scale became established in the east in the early 90's, resulting in an urgent demand for information concerning this insect and its allies. A special study was made of this species and its more important congeners, and the results presented in a comprehensive bulletin on scale insects [N. Y. State Mus. Bul. 46]. This work was supplemented by experiments from year to year with a number of remedial washes, the details being given in annual reports for the last five years. The very destructive grape root worm of the Chautauqua region was carefully studied and many exceedingly important facts learned regarding the pest and the feasibility of controlling it demonstrated. The details are given in Museum bulletins 59 and 72.

Serious injuries to shade trees in the late 90's led to an investigation of the destructive forms, and the results were presented in several reports and bulletins, and summarized accounts given in the fourth and fifth reports of the Forest, Fish and Game Commission. These studies were introductory to work on forest insects, part of which appeared in the seventh report of the Forest, Fish and Game Commission. Field investigations of this group have been continued through a series of years and the general results brought together in a comprehensive memoir on *Insects Affecting Park and Woodland Trees*.

Aquatic insects constitute an important and hitherto much neglected group. Studies of these forms were begun in 1900 and continued to date with remarkable additions to our knowledge. The credit for this is due largely to Dr James G. Needham of Lake Forest College and his collaborators, Messrs Betten and Johannsen. These investigations resulted in a monograph of our dragon flies, special attention being given to the much neglected immature stages, to an as nearly complete account of our May flies, to important additions to our knowledge concerning the Caddis flies, and a portion of the true Neuroptera, Sialidae. The midges, Chironomidae and Simuliidae, exceeding important groups, have been the subject of extended and comprehensive studies by Mr Johannsen, the results being given in Museum bulletins 68 and 86. A monographic account of our stone flies is nearly completed, and a similar work on the Caddis flies in preparation. Many new forms

have been discovered and characterized in the progress of this work, and the Museum publications treating of aquatic insects are essential to the library of every student interested in this important group.

Original studies of mosquitos, a group of unquestioned economic importance, have been prosecuted for several years, the preliminary results appearing in Museum bulletin 79, the first American publication to present a large number of reproductions from photomicrographs of both adult and larval structures. These illustrations are of utmost service, being very nearly essential to the identification of many species. Furthermore, this bulletin presents for the first time an excellent series illustrating the male genitalia, structures possessing a systematic value previously ignored and more fully expounded in an important morphologic paper contained in Museum bulletin 97.

Acknowledgments. The office is indebted to Dr L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture and to members of his staff for kindly determining various insects submitted for name throughout the year. Through the courtesy of Forest, Fish and Game Com'r James S. Whipple, the facilities of Fulton Chain hatchery at Old Forge, N. Y. were placed at the disposal of the office during the time field investigations of aquatic insects were in progress.

Respectfully submitted

EPHRAIM PORTER FELT

State Entomologist

Office of the State Entomologist Albany, October 14, 1905

INJURIOUS INSECTS

Grape root worm

Fidia viticida Walsh

This species must be considered a serious enemy of the vineyardist, though its injuries in the Chautauqua grape region have not been so great during the last two seasons as they were a few years earlier. It is now generally distributed throughout this grape section and a significant development of the last year or two is the extension of its operations to vineyards on the hills back from the lake. Two and three years ago the beetles were very scarce in these vineyards, while last summer both adults and larvae were more prevalent than they had been for some years and in one case at least, decidedly abundant.

Life history and habits. The life history and habits of this species have received much attention in the last three or four years, and considerable data bearing on periods of transformation, the habits of the grubs, beetles, oviposition etc., have been presented in State Museum bulletins 59 and 72, to which the reader is referred for details of much importance in controlling this destructive pest. The latter publication comprises practically everything given in the former together with many additional facts.

Root worm control. The investigations of the last three or four years have shown beyond doubt the practicability of controlling this insect, even in badly infested vineyards. The observations have been continued for the purpose of ascertaining the behavior of the pest through a series of years, in order to obtain a more adequate conception of its destructiveness and the conditions favorable to its multiplication with the resulting injury. The best idea of this insect's work can be gained by reference to a particular case where conditions are known. A very thrifty, well kept vineyard belonging to D. K. Falvay of Westfield was found to be abundantly infested with root worms in the spring of 1903. Most vineyardists know in a general way the results of our experiments. A horse collecting machine was made and as a result of three catchings at intervals of about five days in early July, over 150,000 beetles were taken from the experimental area of about 5 acres, or an average of 59 insects were secured from each vine, in spite of the fact that a considerable proportion of the area had been previously cultivated for the special purpose of killing the pupae, this latter operation undoubtedly destroying from 50 to 75% of the latter. Bearing this in mind, these figures give some idea of the

immense number of root worms which must have been at work in the vineyard before operations commenced. An examination in 1903 showed that the grape roots were very badly scored, and there was a question whether the vitality of the vines was sufficient to outgrow the injury. The vineyard has, as is well known, received excellent cultivation and care, and the following spring collections with the beetle catcher resulted in taking about 6% of the number captured the preceding July; in other words, the numbers of the pest had been reduced by cultivation for the destruction of pupae and the collection of beetles by about 94%, if we make no allowance for the normal increase of those surviving the operations of the previous season. This vigorous action in connection with excellent cultivation and fertilization gave the vines an opportunity to recuperate, and while they grew well throughout the season in 1903 there was still a chance that the root worm injury had made such a draft upon the reserve vitality of the vines as to make it impossible for them to eventually recover. It is very gratifying to state that the observations of 1904 and 1905 show that these fears were groundless. The vines, in spite of the severe damage inflicted in the fall of 1902, and probably to some extent in the early spring of 1903, have been able to overcome the serious injury and the vineyard is now in most excellent condition in every respect. These experiments and their subsequent results should prove of great value to every grower, since they show that a vineyard may suffer considerable injury from such a pest as the root worm and yet be brought back to its normal condition, provided remedial measures are adopted promptly and the vines given an opportunity to recover through excellent cultivation supplemented by judicious fertilization.

The above bit of history is a marked contrast to that of certain vineyards in the same section, some of which have been practically ruined by the root worm, with very little effort on the part of the owner to avert disaster. We know of one at least which was seriously infested by root worms two or three years earlier than that belonging to Mr Falvay and which is still in a very poor condition, owing largely, we believe, to continued and unchecked root worm depredations. Other causes such as extremely light soil, undrained land, etc. may produce weak, unthrifty vines in restricted localities or even over extended areas. These latter by no means explain some of the losses in Chautauqua vineyards. The grape root worm is undoubtedly causing a great deal of damage and here

and there it has multiplied so freely as to nearly destroy the vines.

Experiments with arsenical poisons. The results obtained with these substances last year are given in detail in our report for 1904. The work of 1905 in this direction has consisted largely in making supplemental observations upon the areas sprayed last year. A somewhat peculiar and anomalous condition was found to prevail about the middle of June in our experimental area in E. W. Skinner's vineyard at Portland. It was found that the grubs were then decidedly more numerous under sprayed vines than they were under those which were untreated last year and employed as checks. This condition was exactly the reverse of what was found the preceding fall and may be explained in one or two ways. The application of arsenate of lead protects the vines to a considerable extent, not only from insect injury but from fungous troubles and as a result there was fully as good leaf development on the sprayed vines as elsewhere. The well known preference the beetles exhibit for a thick shelter might naturally lead them to oviposit more largely on the sprayed vines and, owing to the fact that the last of June and early July the foliage was pretty well protected by poison, it may be that a considerable proportion of the eggs were deposited in this area later, and this was borne out by our examinations for egg clusters in 1904. A reference to our report for that year will show that a high percentage of eggs were laid on the sprayed areas late in the season. Grubs from these late deposited eggs are not likely to attain full growth in the fall and as a consequence are much more easily overlooked, so that the apparent discrepancy between conditions found in the fall of 1904 and the spring of 1905 may have been due in part to the better development of foliage attracting more beetles, and in part to the failure of the grubs to attain full size before final counts were made in October 1904. It is at least a peculiar condition, and there is a possibility that some of the grubs found under the vines sprayed the preceding year may have come from eggs deposited by inflying beetles since we know that such migrations occur.

Further evidence on this point, though not entirely of a satisfactory character, was obtained by examining a vineyard near Prospect Station where the beetles, in spite of four sprayings with poisoned bordeaux mixture in which $\frac{1}{4}$ pound of paris green was used for each 50 gallons, had done considerable eating. This vineyard was treated primarily to prevent rot. The first application was made just before and the second just after blossoming, the

others following at intervals of about a week or 10 days. It was stated that the spraying was thorough, though examination leads one to believe that the treatment was concentrated about the middle of the vines for the special purpose of covering the fruit, the lower and upper leaves escaping the application to a considerable extent. The finding of numerous beetles in this vineyard shows that the insects can thrive on sprayed vines and emphasizes the necessity of very thorough work in case one attempts to control them in this manner. The adaptability of beetles to this condition is further demonstrated by finding grubs late in the fall rather abundant under the vines, showing that these insects will select their food whenever there is an opportunity and that they can thrive where other species might succumb readily.

General summary. The observations of the last few years have brought out certain facts rather conspicuously.

They have shown first of all that vines growing on heavy clay soils can withstand greater injuries by root worm than those upon light sandy soils.

They have demonstrated that root worms display a marked preference for the lighter soils, and when vigorous vines are growing thereon the chances of injury are greatly increased.

Our investigations have shown that this insect is to a considerable extent a local species; that is, it may breed in very large numbers in one vineyard or even in a portion of a vineyard and be almost absent from other parts. The reason for this is sometimes seen in greater thrift of badly infested vines and in other cases no ready explanation can be found for the difference.

It has been shown that the beetles fly more or less freely, sometimes entering a vineyard in large swarms and depositing a great many eggs. This fact is of considerable importance because a vineyard free from the pest one season may be very badly infested another. These peculiarities in the behavior of the insect render constant watchfulness necessary on the part of the grower.

Our experiments with arsenical poisons have not been so successful as we had hoped, and though the insect is undoubtedly checked thereby to some extent, we doubt the wisdom of relying wholly thereupon. Experience and investigations show that the applications must be exceedingly thorough in order to obtain even a moderate amount of protection in this manner.

Recommendations. The peculiar and somewhat erratic habits of this insect lead us to emphasize the advisability of watchfulness

on the part of every grower if he would avoid serious injury by root worms.

There is no doubt as to the value of cultivation for the destruction of pupae, and wherever the beetles are at all abundant we would advise as heretofore, that vineyardists plan if possible to have a ridge of firm earth at the base of the vines either in the fall or early spring (preferably the former), and to remove the same with a horse hoe or other implement when the great majority of the insects are in the "turtle" or pupal stage, which is normally from the first to the middle of June.

This measure may well be supplemented by destroying beetles, either by the employment of a beetle catcher or with an arsenical spray. The use of the former is preferable in all vineyards where the insects are very abundant and especially where the vines are growing vigorously. The latter may be employed with safety wherever the vineyard is not badly infested, and particularly on vines not growing rapidly. The employment of an insecticide is most advisable where the berry moth is at all prevalent, because there is no doubt but that the poison kills over half of these insects, and this benefit should be taken into account when deciding on the method of destroying the beetles. It should be remembered that if poisons are used the application should be most thorough, and it is probable that an outfit capable of developing a high pressure and delivering an extremely fine, mistlike spray would give better results than one where the spray is coarser and consequently does not drift in among the leaves to so great an extent.

Our observations show that it is much better to fight this insect at the outset and prevent serious injury to a vineyard, rather than to take chances and spend three to five years in getting the vines back into fairly good condition.

Army worm

Heliophila unipunctata Haw.

This species occurred in large numbers in limited areas of Chautauqua and Erie counties last July. Mr Eugene Merry of Derby informed us that army worms were quite destructive on 17 acres, largely of oats, in the town of Evans, Erie co. The pests appeared July 1 and were abundant about 10 days. No natural enemies were observed. Fortunately the outbreak was not an extensive one and so far as we can learn no serious injuries were inflicted in other sections of the State.

Early history. The widespread depredations of 1896, at which time this pest inflicted its maximum injury, are still fresh in mind. The numbers of this species fluctuate widely at irregular intervals. The first authentic report of injury in New York so far as known occurred in 1817, when many meadows and pastures in the northern towns of Rensselaer county and the eastern portions of Saratoga county were rendered as "barren as heath." Some injury was recorded in 1842 from the western part of the State and severe ravages were committed in 1861 in the vicinity of Buffalo, near the head of Seneca lake and at several other points in the southern and western counties. Depredations by this species were reported from Tioga county in 1871, and four years later it attracted notice the latter part of July and the middle of August on Long Island. It was again destructive in 1880, caterpillars appearing in June on Long Island where they caused much alarm.

Description. This insect is one of our common grass-feeding species, which is present in greater or less numbers in grass fields from year to year. Its habits are such that it is ordinarily observed only when conditions allow it to become abnormally abundant and destructive.

The eggs are smooth, white when first laid, turning gradually to a pale straw color before hatching and are about $\frac{1}{50}$ inch in diameter. They are usually deposited in adhesive masses and may be found between the leaf sheath and the stem of grass, the toughest stalks in the thickest clumps being a favorite place of deposit. They are also laid on herbs, dead stems, stalks and in less favorable places when the moths are abundant.

The young caterpillars, rarely seen, are about $\frac{1}{16}$ inch long, of a dull, translucent color with brownish black or yellowish head with dark eyes. These recently hatched caterpillars walk in a looping manner, somewhat like measuring worms. After the first molt the young caterpillars are $\frac{1}{5}$ inch long, the head is darker and the striping observed in full grown individuals is becoming apparent. The general color of the body is yellowish green with three more or less well defined brownish lines on each side of the body. The looping habit is still continued.

The full grown caterpillar has the head light brown with variable dark brown markings, there being more or less indistinct, broken, oblique, sublateral stripes of dark brown. Thoracic shield light brown with distinct median and sublateral white lines. Body a variable greenish with fuscous markings and with more or less

distinct median, sublateral, lateral and substigmatal, narrow, white lines, the sublateral and lateral separated by a broad, yellowish, brown or reddish mottled stripe and the stigmatal bordering a broad, yellowish brown or reddish mottled stripe, below, which in turn margins the greenish yellow, fuscous mottled ventral surface. The area between the median and narrow sublateral white line is a variable greenish with fuscous markings, there being in some specimens more or less of a fuscous spot on the anterior portion of each segment just above the lateral line. The lateral white line is separated from the stigmatal line by a broad, variable dark band. True legs pale yellowish; prolegs mostly pale yellowish with a more or less distinct fuscous patch externally.

The above represents the more normal type of coloration. Darker individuals are to be found with almost no trace of the narrow median white line. The sublateral, yellowish brown mottled stripe bordered by two white lines appears to be more constant and the same is true of the narrow, stigmatal, white line and its ventral margining, yellowish brown mottled band. Occasional specimens have the sublateral lines nearly obsolete.

The mahogany-brown pupa is about $\frac{3}{4}$ inch long, rather stout and bearing at the posterior extremity a pair of slightly converging spines, and on each side thereof two fine, curved hooks.

The adult is a very modest, reddish gray or fawn-colored moth with a wing spread of about $1\frac{1}{2}$ inch. It may be recognized by the small, rather conspicuous, somewhat triangular white spot in the middle of each forewing, which latter bears at its outer margin in particular a variable series of small black spots.

Life history. The winter is normally passed in the pupal stage, the moths appearing in early spring and depositing their eggs as a rule on coarse vegetation. The caterpillars hatching therefrom feed upon various grasses or grains, increase in size rapidly and in turn transform to moths early in June. These latter deposit eggs as did their predecessors, and the caterpillars hatching therefrom constitute a second brood which is the one that caused the principal injury this season and also in 1896, though occasionally the third brood is destructive in September.

The caterpillars are very retiring in habit, remaining under shelter most of the time. The feeding is done largely during cloudy weather or at night. The young caterpillars eat away the lower epidermis of the leaf much in the same way as do Crambid larvae, beginning to eat holes in the sides of the leaves when about a week

old. There is considerable difference in the rate of development, which is caused largely by the abundance and condition of the food.

Indications of injury. The signs of this insect's presence are not very striking till serious damage has been inflicted. Oats for example appear to be abnormally thinner and on examination it may be found that most of the leaves have been eaten away. An unusually early ripening should arouse suspicion. The characteristic black droppings on the surface of the ground should lead to scrutiny. Light patches in the field should be examined for signs of this insect's work, and a search under stalks, stones or any adjacent shelter may result in exposing the caterpillars.

Natural enemies. This pest has a large number of natural enemies, which are undoubtedly very serviceable in controlling this species. Unfavorable weather conditions destroy many of the hibernating insects and at times a deadly bacterial disease cuts off thousands of caterpillars. Vertebrate enemies such as swine, shrews, skunks, weasels, domestic fowls, specially ducks and geese and various insectivorous birds devour large numbers of the caterpillars whenever they are numerous. Predaceous insects such as the ground beetles and the tiger beetles also aid in the good work, one of the most efficient of the former being the fiery ground beetle, *Calosoma calidum* Fabr.

Native parasites play an exceedingly important part in checking this species. The red-tailed Tachinid *Winthemia quadripustulata* Fabr., sometimes occurs in swarms in an infested field, and its rather large, whitish eggs are frequently observed just behind the head of unfortunate caterpillars. An almost equally abundant and efficient enemy is found in the closely allied yellow-tailed Tachina fly, *Belvoisia unifasciata* Desv. A number of allied species assist in this work and their efforts are supplemented by those of several minute four winged flies, one of the best known of these latter being the so called military microgaster, *Apanteles militaris* Walsh. The rather large, reddish, flattened, wasplike parasite, *Eniscopilus purgatus* Say, is another valuable check upon this species.

Preventive and remedial measures. The most important thing to be borne in mind in connection with this insect is that the moths deposit their eggs by preference on coarse vegetation of one kind or another and as a result army worm outbreaks are likely to occur in the vicinity of rank weed growths such as neglected spots about

stones, untrimmed strips beside fences and similar localities. Farms where clean culture prevails are much less likely to suffer injury than those presenting conditions attractive to the moths, as described above.

The caterpillars of this pest are usually so abundant in an infested field that nothing but heroic and prompt measures will stop their work. Grain badly infested throughout with these insects can be saved only by cutting it at once and drying, because the caterpillars will cease eating as soon as the stalks have become somewhat hard. Usually army worms are very abundant in patches here and there, and advantage may be taken of this and their spreading to comparatively uninfested portions prevented by the use of a series of furrows, bands of tar, narrow boards set on edge and with the face next the pests covered with tar, or other obstacles. The furrows, if they be employed, should be turned away from the portion to be protected, and they can be made more efficient by excavating holes in the bottom at intervals of a rod or two, in which the army worms will drop as they crawl along the furrows seeking a place to escape. The pests can easily be destroyed in such places by pouring on kerosene or even covering with earth and crushing. A strip of tar several inches wide, preferably spread upon a board, will turn the caterpillars aside and it may likewise be made more effective by digging holes close beside it, into which the worms may be trapped as described above. A narrow, smooth board set on edge, tipping a little toward the pests, will also be of value in diverting the insects from the field to be protected.

The caterpillars can be destroyed by spraying crops on which they are feeding with paris green, london purple or other arsenical poison, making a very heavy application with the idea of destroying them at once. A poisoned strip should prove of considerable service in protecting areas beyond and its efficacy may be enhanced by the employment of a poisoned bran mash, using enough paris green or other arsenical poison to give a distinct coloring to the mixture and spreading it liberally in thickly infested sections. Better results will follow the use of this latter if the mash be distributed in the late afternoon, as it would remain moist and attractive to the caterpillars for a longer period. Many army worms may be destroyed by spraying them with kerosene, a strong kerosene emulsion or other contact insecticide. These measures will destroy the caterpillars and are not so dangerous to live stock as though poison was employed.

The essential is to avoid presenting conditions attractive to these insects and lacking that, to detect the presence of the enemy early and then adopt vigorous measures to prevent further injury.

Bibliography

A detailed account of this species is given by the late Dr J. A. Lintner in the 12th Report of the State Entomologist for 1896, pages 190-214.

Grass webworms

Crambus species

The latter part of May 1905 was noteworthy because of the appearance of many purplish, brown headed caterpillars about $\frac{3}{4}$ inch long in grass fields. These webworms were so abundant in portions of Rensselaer, Columbia and Albany counties as to eat practically all the grass within limited areas, producing conspicuous brown patches, which gave rise to considerable apprehension lest the depredations become more extensive and result in great losses. An examination the latter part of May and early in June led us to estimate that in portions of the town of Schodack fully 100 acres had been denuded of almost every green leaf.

Early history. The most severe, widespread injuries by these insects in New York State were recorded by Dr Lintner in his first report for the year 1881. The depredations were confined largely to St Lawrence county. Dr Lintner states that in the town of Potsdam hundreds of acres of pasturage had been destroyed and not one farm, it was believed, had escaped. Some idea of the outbreak may be gained from Dr Lintner's observations which follow: "An upland pasture containing 50 acres, which, 10 days previous to my visit, had afforded good pasturage, was now entirely brown. No grass could be seen in glancing over its whole extent, except over a very narrow strip which had been used as a roadway when farming purposes necessitated occasionally passing from one field to another." On returning, Dr Lintner readily detected the ravages of the caterpillar "at various other places in St Lawrence, Jefferson and Oswego counties, by the brown patches, usually of small extent, on knolls and in the more elevated portions of the pastures bordering the road. Near Richville, several large infested patches were seen. None were noticed at Keen's Station. At about a mile south of Sanford's Corners, in Jefferson county, and continuing for some distance farther, traces of the attack were visible in small brown spots in pastures. Within about 2 miles of

Watertown, it became quite noticeable, and for a few miles beyond, several pastures showed the higher portions infested, and a grain field was also believed to be suffering from it. It was again noticed as we approached Adam's Center and after leaving Sandy Creek, in Oswego county."

A few years later Dr S. A. Forbes, state entomologist of Illinois, recorded severe injuries to corn by the so called corn root worm or better, corn webworm, *Crambus zeëllus* Fern., and in 1891 Prof. Lawrence Bruner reported the same insect as damaging corn in Nebraska and several other states. The latter year the sooty *Crambus*, *C. caliginosellus* Clem. was destructive to corn in Delaware, and similar work was noticed as early as 1886 at Bennings, Md. Injuries by webworms to corn planted on sod were reported by Dr Smith for the year 1893 and in 1894 the garden *Crambus*, *C. hortuellus* Hübn. was recorded by Mr Scudder as a destructive pest of cranberries. Crambids were very injurious to grass lands in Ohio in 1896. Professor Webster states: "I witnessed more widespread, severe injury from these webworms than ever before. Not only have whole fields of corn been swept out of existence, but fields of oats have been as completely destroyed, and on being resown have again been as utterly ruined a second time. In some portions of the State, almost without exception, oats or corn sown or planted on sod lands was entirely destroyed, and in one or two cases even on ground that was the previous year devoted to wheat, these crops have suffered also." These insects have also been more or less injurious to corn and tobacco, particularly in Maryland, specific cases being recorded by Professor Johnson for the years 1897 to 1900 inclusive. The damage was in each case attributed to the sooty *Crambus*, *C. caliginosellus* Clem., and invariably occurred on land which the previous year had been in grass.

Life history and habits. There are about 20 native species of close-wings or Crambids, parents of grass webworms. They are all, so far as known, grass feeders by preference and closely resemble each other in life history and habits. The moths are easily recognized by their peculiar position in connection with their limited flight. They invariably occur in grass lands and when flushed fly but a rod or two, alighting on a stem or blade of grass with the body parallel thereto, the wings wrapped closely about the abdomen and the conspicuous palpi extending directly forward. The peculiar manner of holding the wings has led the English to bestow

upon them the common name of close-wings. A series of trap lanterns were run at Cornell University in 1889 and the material therefrom shows that different species of Crambids fly from the latter part of May throughout October, the greater number being abroad in July, fewer in June and August and only one or two species in May and September. This variation in the period of flight probably indicates a corresponding difference between the time the caterpillars of the several species attain maturity. This is of considerable importance because most caterpillars feed much more heartily just as they are completing growth, and were this destructive period in the various species distributed over a series of weeks the caterpillars would obtain a maximum amount of food with a minimum injury to the grass. This is very probably what occurs in nature.

The life history of these forms, so far as known, may be summarized briefly as follows: The adults fly as described above and drop their pearly white or yellowish, strongly ribbed eggs at random in the grass, caterpillars hatching therefrom in about a week. The young larvae obtain shelter at the base of grass stalks and at first eat only the underside of the leaf, leaving the upper epidermis. They soon construct a cylindric, web-lined retreat to which they retire during the day. As they attain a little size, portions of the leaf are eaten away and soon the young caterpillar is strong enough to cut off a blade of grass, drag it to its nest and even end it up and draw the end down into its web-lined shelter. This is evidently a provision so that the little creature can feed during the day without exposing itself to attacks from various natural enemies. The partly grown webworms pass the winter in their web-lined retreats and in the spring renew their feeding, those of the vagabond Crambus, *C. vulgivagellus* Clem., completing their growth the latter part of May or early in June, at which time the cocoon is spun. The caterpillars, however, remain unchanged in their shelters for about two months or through June and July, and the moths appear in the case of this species during the latter part of August and may be observed throughout September.



Fig. 1 *Crambus trisectus*, tube of older larva at base of grass stem, enlarged (Redrawn from author's illustration)

Natural enemies. Webworms are subject to attack by a number of natural enemies, which are undoubtedly of much service in



Fig. 2 *Crambus albellus*, larval tube or nest in grass, the lower portion exposed by the removal of a little humus (Redrawn from author's illustration)

keeping the pests within bounds. A minute four winged fly, *Lampronota frigida* Cress., was reared from the caterpillars by Dr Lintner in 1881, and Dr Riley obtained another form, *Cryptus mundus* Prov. A small Tachanid, allied to the one which is so efficient in checking army worm outbreaks, was bred from larvae by Dr Lintner, who observed in the infested fields a well known caterpillar hunter, the fiery ground beetle, *Calosoma calidum* Fabr. This latter insect is undoubtedly a valuable ally in checking grass webworms. We would

expect in addition that many of the smaller ground-feeding birds would destroy a large number of these grass pests.

Remedies. Grass webworms, as has been pointed out above, live by preference on members of the grass family and ordinarily abound only in grass lands. Their invasion of corn fields, tobacco fields and cranberry bogs must be considered more or less accidental, particularly as their depredations in these latter are usually much more marked on the borders of fields adjacent to grass than elsewhere. This naturally suggests the advisability of keeping crops likely to suffer injury from these pests as distant from grass lands as practical. Corn and tobacco fields and possibly cranberry bogs could be surrounded by several rows of potatoes, for example, in localities where these pests are likely to cause trouble.

Another condition leading to injury is when grass sod badly infested with these webworms is plowed and then planted with some crop upon which the caterpillars can feed. This is the usual explanation where there is extensive and serious damage to either corn or tobacco, and the obvious remedy is so to arrange operations when practical as to render such an outbreak impossible. Plowing of the infested land in late summer or early fall, in August or early in September, should result in most of the caterpillars perishing before the following spring. This can not always be done, and danger of injury by those species of webworms which

feed in early spring may be obviated to some extent by delaying the plowing as late as possible, so as to give the caterpillars an opportunity to complete their growth before some other crop appears. Early spring plowing of such fields may only aggravate the injury by retarding the development of the caterpillars, with the result that when corn or some other crop begins to appear it is speedily devoured by hordes of half starved webworms. The destruction of a crop under these conditions may be avoided to some extent by putting in from one half to double the usual amount of seed, thus increasing at the outset the chances of securing a fair stand.

Nothing can be done to prevent injury by these pests to badly infested grass lands after the characteristic brown patches have begun to appear, because the labor involved would amount to more than the value of the crop to be protected. Ordinarily such an outbreak means simply the loss of a considerable proportion of the grass for that season, as the webworms rarely feed on grass roots to any extent. There is therefore no necessity of plowing such lands unless one be desirous of obtaining a green crop of some kind, and as pointed out above, the sowing should be delayed a little in order to enable the webworms to complete their growth before the new crop begins to develop.

Literature. Literature relating to these insects is somewhat scarce and consists for the most part of brief records of injury to grass or grain crops. An economic account of these insects is given by the author in bulletin 64 of the Cornell University Agricultural Experiment Station, and Prof. C. H. Fernald has monographed the entire family in the 33d annual report of the Massachusetts Agricultural College, 1896, pages 77 to 160, to which the reader is referred for additional information concerning these insects.

Important species. There are several of these forms which have caused more injury than others and it is of some importance to be able to recognize them, consequently the following brief descriptive accounts have been prepared.

Vagabond Crambus

Crambus vulgivagellus Clem.

The adult is a very ordinary appearing moth having a wing spread of $\frac{3}{4}$ to $1\frac{1}{4}$ inches. The general color is a yellowish gray though the forewings are flecked with black and with black dots

on the vein tips. The very long, black flecked labial palpi are most characteristic of the insect. It is the form which was largely responsible for the extensive outbreak in the St Lawrence valley recorded above and is probably fully as destructive to grass in this section as any Crambid.

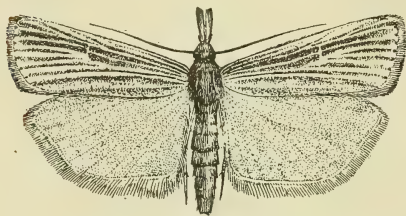


Fig. 3. *Crambus vulgivagellus*, enlarged
(Original)

Description of early stages.

The moths fly about dusk during the latter part of August and the first half of September and are attracted to light in large numbers, though a considerable proportion of the captures are males.

The pale straw-colored eggs turn to a reddish buff color before hatching. The very young larva is only about $\frac{1}{25}$ inch long and has a dark brown head, an olive-colored thoracic shield and a straw-yellow body. Late in the fall the young caterpillar may be nearly $\frac{1}{8}$ inch long. The head is then jet-black, the thoracic shield a deep brown and the brown body ornamented with dark brown hairy tubercles. The full grown larva (presumably this species) is about $\frac{3}{4}$ inch long with a very dark brown almost jet-black head. The thoracic shield is dark brown, shining and the body a dull reddish brown or olivaceous with well developed, dark brown tubercles, each bearing a moderately long, stiff, brown hair. The thorax and abdomen are a little wider than the head, the latter being broadest near the middle, tapering somewhat toward the posterior extremity. Anal shield well developed, variably dark brown. True legs dark brown, prolegs dark brown, olivaceous. Ventral surface light yellowish brown.

Life history. The moths fly more or less during the day, particularly in shady places. The females are quite prolific, one depositing 320 eggs after capture, which is probably about the normal number. The young larvae remain for a time coiled up on a leaf in plain sight when not feeding, and if disturbed lie quiet for a minute and then try to escape, or they may drop at once by a silken thread. The larvae feed mostly during the day as cold weather comes on and occasionally may be seen eating in the early morning. They devour the soft parenchyma at first and later the whole leaf is consumed. This species feeds mostly on grass though it eats small grains, and winters as an immature larva which resumes feeding in the spring, completes its growth the latter part

of May or in early June, spins a cocoon and some two months later pupates, the moths appearing in August and September.

Dried Crambus

Crambus trisectus Walk.

This species is a rather large, ashy gray moth having a wing spread of $\frac{7}{8}$ to $1\frac{1}{4}$ inches. The forewings are ornamented with two irregular, oblique characteristic black markings. The moths fly mostly at or just after dark and are attracted to light in large numbers, being on the wing throughout June and July, though individuals have been taken the latter part of September. This species, as recorded by Dr Lintner, was associated with the vagabond *Crambus* in the unprecedented outbreak observed in the St Lawrence valley. Our collections at Ithaca show that it is about as abundant as the preceding species, and like it should be regarded as a serious pest in grass lands.



Fig. 4. *Crambus trisectus*, enlarged
(Original)

Description of early stages. The eggs are a cream-yellow when first laid, gradually turning to an orange-buff color before hatching. The very young larva has a black head, a dark brown thoracic shield and the body is a translucent white with numerous small black tubercles, each bearing one or more light colored hairs. The larva in late fall is about $\frac{1}{12}$ inch long with the head and tubercles black, while the body is a mottled chocolate-brown with a dark stripe along the dorsal line. In early spring the head and thoracic shield are a dark amber, the tubercles of the same color and there is a dull pinkish line along the middle of the back, and irregular dark wavy subdorsal and lateral lines, the body being a pale straw color.

The oval cocoon is just below the surface and composed of a thick layer of bits of grass with particles of soil adhering. Within it is smoothly and thinly lined with silk.

Life history. This species appears to be moderately prolific, as one female deposited 150 eggs after capture and it is estimated that between three and four hundred may be produced. The newly hatched larvae show a marked preference for the axle of a leaf,

where they eat the soft paranchyma, feeding most voraciously. They begin to spin webs in these retreats when about a week old

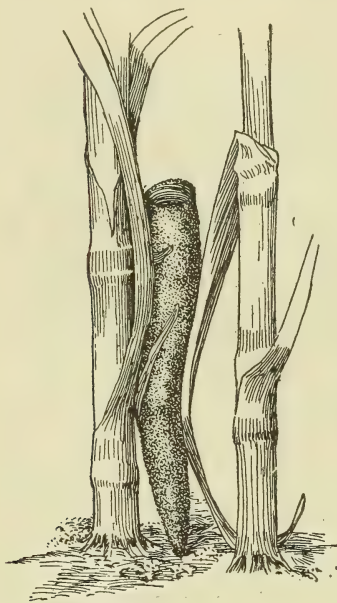


Fig. 5 *Crambus trisectus*, larval tube at base of grass stem, enlarged (Redrawn from author's illustration)

and frequently several leaves are fastened together, in the midst of which the caterpillars feed. They will also subsist on sheep sorrel if grass is not available. The last of September, about a month after hatching, the young caterpillars construct near the surface of the ground cylindric perpendicular nests which are usually attached to one or more stalks of grass. The outside of this retreat is covered with finely chewed bits of grass, while the inside is smoothly lined with silk. The nests are about $\frac{1}{4}$ inch long and $\frac{1}{16}$ in diameter. They are strengthened as necessities demand by the addition of more grass to the outside and occasionally a large piece is attached to the side of the nest, though usually the pieces are small and of nearly the

same size. The larvae retire for the winter about the first of November, closing the free end with a bit of grass. Some nests have an underground chamber and a passage which probably allows the exit of the larvae during mild days and gives them access to the roots of grass. The larvae come forth in the spring and according to Dr Lintner complete their growth and pupate in June, the insects appearing 15 days later.

Dark-spotted *Crambus*

Crambus mutabilis Clem.

This species, with a wing spread of about $\frac{7}{8}$ inch, may be recognized by the dark spot near the middle of the slaty forewing. There is also a dark subterminal line which is usually rubbed so as to give the appearance of a second dark spot. It is a larger species than the sooty *Crambus*, *C. caliginosellus* Clem., which it resembles somewhat. The moths fly the latter part of the afternoon and early evening during June, July and even in August and September. This close-wing seems to be confined to low or damp land and is easily attracted to lights. The species is a

very common one at Ithaca and is undoubtedly an important grass pest. It is one of several found by Professor Webster causing serious injuries to the grass and grain lands of Ohio in 1896.

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange-red color before hatching. The young larva has a pale yellowish head flecked with sooty specks and the body is dark, semitransparent, white with irregular reddish blotches along the dorsum. Scattered dark colored hairs occur on the head and body.

Life history. This species appears to have an exceptionally long breeding season, as adults may be observed from June to September and possibly there are two generations annually. The period of oviposition lasts a week or more. One female deposited 200 eggs the day after being captured, 200 the next day and 100 the third, and at the end of the week had produced 727 eggs.

Yellow Crambus

Crambus luteolellus Clem.

This rather uniform, yellow Crambid with a wing spread of $\frac{3}{4}$ to 1 inch, appears to be confined to low, wet lands, the moths being abroad at dusk during the latter part of June and July. It was a rare species at Ithaca, though Professor Webster lists it as one of the five species responsible for extensive injuries to the grass and grain lands of Ohio in 1896. Practically nothing is known of its early stages except that the eggs are a light reddish color when first laid and ornamented with 14 prominent longitudinal ribs. It is closely related to the following species.

Sooty Crambus :

Crambus caliginosellus Clem.

This small, dark colored moth with obscure markings has a wing spread of from $\frac{1}{2}$ to 1 inch. The adults are abroad in early evening during the latter part of July and the first week of August, very few being attracted to lights.

This insect is best known because of its injuries in the corn and tobacco fields of Maryland. It does not appear to be an abundant or destructive form in New York State.

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange red color. The young larva has a pale amber head and is a dirty, translucent white with irregular, reddish spots on the middle line of the back. Scattered light colored hairs occur on both the head and body.

Life history and habits. This species appears to be moderately prolific, as one female deposited 275 eggs. The habits of the larva



Fig. 6 *Crambus caliginosellus*, enlarged (Original)

have been described by Professor Beckwith practically as follows: The caterpillars remain feeding on the tender inner portions of the corn, working just beneath the surface of the soil. Some stalks are nearly girdled and the worms are frequently imbedded in cavities they have excavated. Sometimes as many as 30 caterpillars were found in a hill, some stalks of which were entirely destroyed and in others the stalks were small, yellow and sickly. The greatest injury was inflicted in the portion of the field adjoining a small strip of timothy sod. It is probable that the moths flew into the field from the adjacent grass, dropped their eggs and the young larvae hatching therefrom caused the trouble above described.

Corn root worm

Crambus zeëllus Fern.

This is a dull, leaden gray, yellowish marked moth with a wing spread of from $\frac{3}{4}$ to nearly 1 inch. It appears to be rare in New York State, though it has been recorded from Maine, Pennsylvania, West Virginia, Illinois and Missouri and has been reported as a serious pest of corn. It is one of five species which Professor Webster considers responsible for extensive injuries to the grass and grain lands of Ohio in 1896.

Description of early stages. The larva has been described by Dr Forbes as follows:

Head dark chocolate-brown, slightly and irregularly rugose, with long yellowish hairs; upon the front a white S shaped mark; cervical shield yellowish, with a white median line; anterior edge whitish, and an oval black spot on the sides. Below the lateral edges of the cervical shield are two hairy tubercles; second and third segments of thorax each with two rows of hairy tubercles, the anterior of four, the posterior of two large quadrate spaces, sometimes united in the middle. From the 4th to the 10th segment the hairy tubercles above the spiracles are in two transverse rows of four each, those of the anterior row being quadrate with rounded angles, and as large as the interspaces; those of the posterior row transversely elongated, about twice as long as wide. Lateral tubercle of anterior row immediately above the spiracle emarginate at its posterior inferior angle, on all the segments from the sixth to the ninth; on these segments a smaller tubercle behind and beneath the spiracle; and two others between the spiracle and

the proleg; a narrow arcuate tubercle, with long hairs outside, in front of each proleg. Anal shield smooth, reddish brown, with a few long brown hairs; spiracles dark brown. Ventral surface paler than the dorsal. Length of full grown larva, .6 to .8 of an inch; greatest width, .1 inch.

Life history. This species was studied by State Entomologist Forbes of Illinois, who found the larvae inflicting considerable injury on corn, attaining full growth the latter part of June or early in July, adults appearing July 22. It is probable that the life history of this species agrees closely with that of others. The eggs are presumably dropped at random in the grass and the partly grown caterpillars hibernate in web-lined retreats. There may be two generations annually, as pointed out by Dr Forbes.

Paneled Crambus

Crambus laqueatellus Clem.

This moth with a wing spread of $\frac{7}{8}$ inch may be recognized at once by the two white stripes extending the greater length of the dark brown wings and separated by a brown stripe of almost equal width. The species was a rather abundant one at Ithaca in May and June in 1896 and is one of several which committed serious injuries to the grass and grain fields of Ohio the same year.

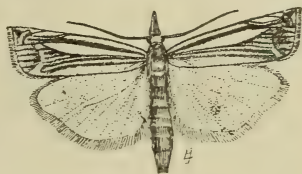


Fig. 7 *Crambus laqueatellus*, enlarged (Original)

Description of early stages. The eggs are creamy white when first laid, gradually turning to an orange color before hatching. The young larva has a brownish black head, a light brown thoracic shield and a pale body mottled with bright red and bearing blackish tubercles. The full grown larva is unknown.

Life history. This form is the earliest to appear in New York State and is also remarkable because more females than males were taken in trap lanterns. This insect seems to be a prolific one, as each of several females laid over 200 eggs, which is probably below the average. These hatched in about 12 days and the larvae, though quite active, refused to feed on timothy and therefore perished. Practically nothing else is known of the habits of this species.

Garden Crambus

Crambus hortuellus Hübner.

This little species with a wing spread of $\frac{5}{8}$ to $\frac{7}{8}$ inch may be recognized by its linear markings of yellow and silvery gray com-

bined with short, black lines and dots. It is a very common species in grass lands during July and has attracted considerable attention because of its injuries to cranberry bogs, where it is known as the cranberry girdler.

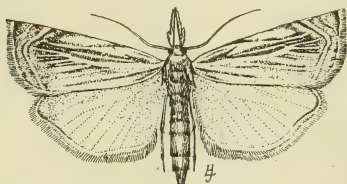


Fig. 8 *Crambus hortuellus*, enlarged (Original)

Description of early stages.

The eggs are creamy white when first laid, turning to a pinkish red before hatching. The young larva has a smutty white color with the head a little darker than the rest of the body. The full grown larva, as characterized by Scudder, has a yellowish head and thoracic shield and the dark body is sparsely clothed with bristles, the longer ones being nearly as long as the width of the body.

Life history. This is a very prolific species, one female depositing 700 eggs. They hatch in about 10 days and the young larvae are very strong and active. They soon construct vertical cylindric nests at the base of grass stalks, covering the outside with bits of dry grass and lining them with silk. The larvae become dormant as cold weather approaches and in November the nests are reinforced with additional silk and the tops closed, affording a secure retreat for the winter. Professor Scudder's observations on this species as a cranberry insect show that the larvae occur in silken galleries beside the prostrate stems or runners upon which they feed. The injury was more marked on the edges of the field, presumably near grass. He found that the cocoons were spun at the surface of the soil and strengthened with particles of sand. They remained therein till the latter part of May or early in June apparently without any feeding, transformed to pupae, and a month later the moths emerged.

Remedies. This species, according to Mr Scudder, can be checked on cranberry bogs by flooding them for five days directly after picking the crop. This destroys the larvae, and where the injury to cranberries is serious this measure might be supplemented by keeping adjacent fields cultivated or in some crop other than grass, upon which this species and its allies thrive.

Experiments in controlling San José scale

Aspidiotus perniciosus Comst.

The following experiments against this insect during the season of 1905 were confined largely to testing several lime-sulfur washes

with a view of ascertaining the most efficient preparation and at the same time obtaining more data upon the reliability of these washes under New York conditions. This latter was particularly advisable owing to the unfortunate results obtained during the season of 1904 in New Jersey, and given wide publicity in the early fall. This consideration led us to conduct experiments at Oyster Bay, L. I. making applications in particular to both pear and apple, as the wash was said to be less efficient on these fruit trees than on peach. Corroborative experiments were also carried on, partly in duplicate, on apple and pear trees in an orchard at Washingtonville. The necessity of boiling the wash by an ordinary application of heat or the employment of a chemical to facilitate combination was also investigated. There was slight ground for believing that a very finely divided sulfur might destroy the scale insects if exposed to the oxidizing effects of moisture and air, and to determine this a few limited experiments were tried with a fine amorphous sulfur kindly supplied by Mr F. H. Pough, general manager of the Bergen Port Sulphur Works. Unfortunately this material proved a total failure so far as controlling scale was concerned. The much talked about combinations between kerosene and a carefully hydrated magnesian lime, designated as K-L mixtures were also experimented with to some extent and the results of other applications observed.

Both the Oyster Bay and Washingtonville orchards contained an abundance of badly infested trees, and through the kindness of Mr J. T. McCoun, the owner of the first, and Mr C. R. Shons, proprietor of the latter, every facility was placed at our disposal. Careful plans were made and the actual work of application was intrusted to Assistant Entomologist D. B. Young and Assistant I. L. Nixon. Owing to the limited time during which the work could be done and a succession of windy unfavorable days in connection with the great difficulty of obtaining careful men to do the spraying, not all the trees were covered as thoroughly as desirable. Several trees at least in each lot were very well sprayed and these were used as a basis for determining the efficiency of the various washes. The writer made a personal investigation of the work a few days after it was completed, and the comments on the thoroughness of the work at that time were probably influenced to some extent by the inevitable washing during an interval of a week or 10 days. This is further sustained by the generally favorable results apparent as the season progressed. The record of the field work together with the results noted is given below.

Formula 1

This wash, consisting of 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water was prepared by bringing several pails of water nearly to a boil in an iron kettle, adding the lime, following at once with the sulfur and stirring vigorously and maintaining an active boiling for at least 30 minutes. The wash was then strained and diluted to the requisite amount with cold water. The first lot of this wash became a deep green before boiling was completed. There was more sediment than usual, about $2\frac{1}{2}$ quarts, apparently mostly sand. This was applied March 31 in the orchard of Mr J. T. McCoun at Oyster Bay, to 16 young apple-trees in row 2, the first four receiving two sprayings. The wash changed to a yellowish green after being applied. An examination April 15 showed that the four trees twice sprayed were well covered, though a few twigs were missed. The application appeared to be rather thin and the trees were lead-gray. There was no sign of washing. July 11 the insecticide was very apparent and there was very little evidence of breeding. September 26 the trees were examined again and very few young scale insects were found.

Another lot of the wash was made April 2 and applied to row 7 in the same orchard. The only difference in the wash observed was that the color was a red-orange instead of green after standing the usual time. The coating seemed to be thinner when examined April 15 than was the case in row 2 and there was some more breeding July 11. September 23 the scale insects were breeding somewhat and the conditions were not bad, although the trees were very thickly infested the preceding spring.

This wash was also applied April 4 to nine greening trees in the apple orchard of C. R. Shons at Washingtonville. It began to sprinkle before the spraying was completed and during the night there was considerable rain till 10.30 the next morning. The trees did not show much washing and when examined April 14 it was seen that the general application was very good, though a trifle thin. July 13 there was very little or no breeding and the wash was plainly evident. September 28 there was only a slight infestation and very little breeding.

This wash was also applied March 30 to 13 peartrees belonging to J. T. McCoun at Oyster Bay. The reaction was excellent, an orange color being obtained in 10 minutes and gradually changing to red-orange and in 30 minutes to a dark pea-green. There was nearly a quart of sediment and this probably made trouble for the

pump, as there was some difficulty in operating it. Examination April 15 showed that the tops of most of the trees were skipped, while the lower portions were fairly well covered. There was very little breeding July 11, and September 26 young were more abundant and on some trees there was considerable breeding, due probably to the trees not being thoroughly covered.

Another lot was applied April 4 to 17 peachtrees in the orchard of Mr Shons at Washingtonville. The preparation of the wash gave the usual reaction except that a wine-red color was obtained. An examination April 14 showed that tree 1 was fairly though rather thinly covered. There was no evidence of washing. July 13 there was very little or no breeding and the wash was still evident and on September 28 there was very little breeding.

Formula 2

This wash, composed of 25 pounds of lime and 20 pounds of sulfur to 50 gallons of water differs only from formula 1 in calling for a larger amount of lime and sulfur. The method of preparation in both instances was identical. The first lot was made with lime from the bottom of a barrel, and as the action was very slow an additional 2 pounds was added about two minutes later. This increased the chemical action and continued it much longer. The wash was a deep red in 20 minutes and eventually became a deep green. There was less than a quart of sediment. It was applied March 30 to 15 apple trees in the orchard of Mr McCoun at Oyster Bay. An examination April 15 showed that the first four trees were well covered except for a few twigs that were missed and that more were skipped where there was but one application. The former trees were well and the latter thinly covered. July 11 the wash was visible to some extent and there was a little more breeding on near-by trees treated with formula 1. September 26 there was some breeding though none of the trees were in a bad condition.

Another lot of this wash was prepared April 7 and applied to seven greening trees in the apple orchard of Mr Shons at Washingtonville. This lot was boiled 30 minutes and stood as long, becoming at the end of this period a pea-green color. An examination April 14 showed that the application was only fair, limbs being skipped in places even on the first tree. The insecticide adhered well to the twigs and there was no evidence of washing. July 11 the wash was easily seen and there was very little or no breeding. September 28 very few young were to be found.

Another lot of this wash was prepared March 30 and applied to 18 Bartlett peartrees belonging to Mr McCoun at Oyster Bay. The action in this instance was very good, becoming orange, gradually changing to red and upon standing till after lunch was a very dark green. There was about a quart of sediment. Upon examination April 15 it was seen that the lower portions of trees 1 and 4 were well covered. July 11 there was some breeding and the same was true September 26.

Formula 3

This wash, composed of 20 pounds of lime, 15 pounds of sulfur and 10 pounds of sal soda to 50 gallons of water, was prepared by placing the lime in four or five pails of hot water, following at once with the sulfur and sal soda. The mixture was then stirred vigorously, and in case the reaction was violent enough to threaten boiling over, a few quarts of cold water were added from time to time. The wash was covered with burlap as soon as danger from boiling over had passed, and allowed to stand 30 minutes. It was then diluted with the requisite amount of cold water. The first lot was prepared March 31 and the action was comparatively mild, there being no necessity of adding cold water to prevent boiling over. The final color of the clear liquid of the wash was a brick-red and there were about 3 quarts of sediment, mostly sand. This wash was applied to five appletrees in Mr McCoun's orchard at Oyster Bay. An examination April 15 showed that the first four trees were pretty well covered though some twigs were missed. The more thoroughly sprayed limbs were moderately white, while those receiving only one application were lead-gray. July 11 there was apparently no breeding in spite of the fact that the trees were so badly infested by scale the previous year that a considerable proportion of the limbs were dead. September 24 the scale was breeding to a limited extent.

The same wash was applied at Washingtonville April 4 to 17 appletrees. The reaction in this instance was slow and continued about 15 minutes. The color of the clear liquid became wine-red. There was very little sediment. An examination April 14 showed that the first tree was fairly though not thickly covered and that the application to the other trees could be classed as fair. The insecticide was thicker on the first tree and there were no signs of washing. July 13 there was very little or no breeding and the wash was still evident. September 28 there was very little breeding and the application seems to have been entirely successful.

Another lot of this wash was made up April 7 and applied to 20 appletrees in Mr Shons orchard at Washingtonville. The action was good in this instance and continued for at least 10 minutes. The wash was an orange-red when stirred and the clear liquid had a wine color. An examination April 14 showed that the first tree was fairly well covered and there were no signs of washing. Very little breeding was evident July 13 and September 23 the conditions were very satisfactory.

Another lot of this wash was made up March 30 and applied to 17 Bartlett peartrees in Mr McCoun's orchard at Oyster Bay. The action was so mild in this case that the addition of cold water was not necessary to prevent boiling over. At the end of 30 minutes the color was a red-orange and there was very little sediment. A lump about the size of one's fist was not reduced. This lot for some reason or other kept clogging the nozzles and gave considerable trouble in this respect. An examination April 15 showed that the first tree was pretty well covered and the tops of the other trees skipped though otherwise well sprayed. July 11 there was some breeding and the same was true September 26.

Formula 4

This wash, composed of 25 pounds of lime, 20 pounds of sulfur and $12\frac{1}{2}$ pounds of sal soda to 50 gallons of water, differs only from formula 3 in being more concentrated. The first lot prepared gave a very good reaction. The mixture rose nearly to the top of the barrel though it was not necessary to add cold water to prevent its boiling over, possibly due in part to a strong, cool wind blowing. The reaction continued for 20 to 25 minutes. There was a considerable amount of sulfur which did not appear to be acted upon, possibly 2 quarts and an equal quantity of residue, probably sand. In this instance but $11\frac{1}{2}$ pounds of sal soda were added because of the limited supply at hand. This wash was applied March 31 to 18 appletrees in the orchard of Mr McCoun at Oyster Bay. April 15 the first four trees were moderately well covered though some twigs were missed on one side. There were no signs of washing. The color of the limbs and branches twice sprayed was grayish white and that of those receiving a single application, lead gray. July 11 the wash was quite apparent and there was very little breeding on tree 2 and some breeding on trees 3 and 4. September 26 there was comparatively little breeding on the first four trees and the results may be considered very satisfactory after making allowance for conditions.

Another lot of this wash was prepared April 5 and applied to nine Ben Davis apple trees in the orchard of Mr Shons at Washingtonville. The water in this case was not boiling hot and there was consequently very little reaction, so slight that it was not regarded as having been sufficiently cooked. Steam was therefore turned on and the preparation boiled for 10 minutes, at the end of which time it was orange-red. Rain interfered with the application and continued all night. The sprayed trees showed some signs of washing though the insecticide was visible upon all. April 14 a close examination showed that there was a little even on apparently bare spots. The wash adheres well to the twigs. July 13 the wash was evident and there was as a rule very little breeding. Some of the fruit was slightly spotted, due probably to portions of twigs being skipped. September 28 there was not much breeding though there was a little more than on the adjacent row in this orchard, sprayed with formula 1.

Another lot of this wash was made up March 30 and applied to 22 Bartlett pear trees in the orchard of Mr McCoun at Oyster Bay. The reaction was very satisfactory, it being necessary to add some cold water in order to prevent the wash from boiling over. The color was very satisfactory, ranging from orange to orange-red. An examination April 15 showed that the lower branches of the first three trees were fairly well sprayed. The application was thick and there were no signs of washing. July 11 breeding was rather abundant and it was continued September 26. The abundance of young in this instance may be accounted for largely by the untreated upper portions of the trees.

Another lot was prepared April 5 and applied to 17 peach trees in the orchard of Mr Shons at Washingtonville. The reaction was very active and lasted but five minutes, producing an orange-red color. An examination April 14 showed that many portions of the limbs were skipped and that the wash adhered well even on the twigs. There was very little breeding evident July 13 and the same was true September 28.

Formula 5

This wash, composed of 30 pounds of lime and 15 pounds of sulfur to 50 gallons of water depends upon the heat generated by the slaking lime to bring about a combination between the lime and sulfur. The latter was first made up with about 2 gallons of boiling hot water in a barrel and this was then stirred into the barrel

containing the lime, adding at once enough to make 9 gallons of boiling water. It was found necessary to add 2 gallons more or the material would have been dry before the reaction stopped. The latter was very violent, and after being covered and standing 30 minutes was a bright orange. There was about 1 quart of sediment. This wash was applied March 31 to 18 appletrees in the orchard of Mr McCoun at Oyster Bay. April 15 it was seen that the first two trees were well covered except in the case of a few twigs. The spray was moderately thick on these and on those treated with only one application the color was lead-gray, the application being thin and more twigs missed. There was no appreciable washing. July 11 the wash was still apparent on the first tree and there was very little breeding in spite of the scale being so abundant the previous season as to kill many limbs. September 26 there was a limited amount of breeding.

Another lot of this wash was prepared April 7 and applied to 17 appletrees in the orchard of Mr Shons at Washingtonville. The reaction was very violent and over in seven minutes. There was a large amount of sediment, probably 4 quarts. The wash did not spray well. An examination April 14 showed that the first tree was well covered in places, only one limb apparently escaping treatment. There were no signs of washing. July 13 very little breeding was evident except on the third tree where there was considerable on a badly infested limb which was probably skipped in part. September 28 there was very little breeding as a rule.

Formula 6

This wash, composed of 15 pounds of lime and 15 pounds of sulfur to 50 gallons of water differs only from formulas 1 and 2 in calling for equal amounts of lime and sulfur. One lot was prepared April 7 and applied to six Ben Davis trees in the apple orchard of Mr Shons at Washingtonville. It was boiled 30 minutes, at the end of which time it was an orange-red color. An examination April 14 showed that the first tree was well covered and the others moderately so, with some twigs skipped. The wash adheres very well even on the twigs. July 13 there was very little or no breeding and the wash was quite evident. September 28 there was very little breeding and the results were generally very satisfactory.

Another lot of this wash was made up March 30 and applied to 23 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay.

This lot was boiled very rapidly for about 30 minutes, at the end of which time it was a dark green. There had been a shower and the trees were somewhat damp at the time of application. There was quite a little rain during the following night and while the wash was very apparent on the trees the next day, it showed a little washing from the rain. April 15 the application appeared to be fairly even and showed slight signs of washing. July 13 there was comparatively little breeding and the same was true September 26.

Formula 7

This wash, composed of 20 pounds of lime and 15 pounds of a specially fine grade of sulfur, known as the amorphous form to 50 gallons of water, was prepared by first slaking the lime and allowing it to cool, then thinning it to something like whitewash and adding the sulfur. There was some difficulty in mixing in the latter because it lumped rather badly. The preparation was forced through a screen on adding the requisite amount of water before spraying. It was applied to a few apple-trees on the south side of the apple orchard of Mr McCoun at Oyster Bay. April 15 it had washed badly except where there was an abundance of scale which aided in keeping it in place. July 11 there was a large amount of breeding and it was plainly evident that this preparation was of comparatively slight value.

Formula 8

This wash, composed of 25 pounds of lime and 20 pounds of the extra fine amorphous sulfur to 50 gallons of water was prepared in the same way as formula 6, and applied April 1 to a few apple-trees on the south side of Mr McCoun's orchard at Oyster Bay. The results were practically the same as those recorded for formula 7. These two experiments indicate plainly that comparatively little dependence can be placed upon the beneficial action of elemental sulfur alone. A certain portion of it at least must be brought into combination with the lime in order to obtain satisfactory results.

Formula 9

This wash, composed of 40 pounds of a high grade carefully hydrated magnesian lime known as limoid and 10 gallons (20%) kerosene to 38½ gallons of water, was prepared as follows: The kerosene was added to the limoid and stirred into a smooth paste. There was a slight excess of kerosene and an additional pound of

limoid was necessary to take it up. Then four pails of water were added and stirred in vigorously with a hoe. The oil seemed to emulsify very readily. This was then put through a force pump for four minutes before being applied. It sprayed nicely and there was no sediment. An examination the next day showed that the trees were very white and the application seemed to have spread over the tree as well as in the case of lime-sulfur washes. This wash was applied March 31 to 14 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay. An examination April 15 showed that the trees were whitish with the lime. There was no odor of kerosene and living scale were easily found. July 11 breeding was rather abundant and September 26 young scales were present in large numbers.

Formula 10

This wash, composed of 50 pounds of limoid and $12\frac{1}{2}$ gallons (25%) kerosene to $34\frac{1}{2}$ gallons of water is the same as formula 9 except that there is a slightly larger amount of kerosene, there being 25% oil in place of the 20% oil in formula 9. It was prepared in the same way as the other. There was as in the preceding case a slight excess of kerosene though the paste was somewhat thicker. This was applied March 31 to 14 Bartlett peartrees in the orchard of Mr McCoun at Oyster Bay. It did not spray as well as formula 9 and the nozzles clogged somewhat. An examination April 15 showed that the trees had a whitish appearance. There was no kerosene odor and living scale was easily found. July 11 there was rather abundant breeding and September 28 young scales were very numerous.

Formula 11

This wash, composed of 40 pounds of lime and 10 gallons (20%) kerosene to $38\frac{1}{2}$ gallons of water is the same as formula 9 except that a carefully hydrated calcium or ordinary stone lime was used in place of the magnesian lime sold under the trade name of limoid. The lime was carefully dry slaked by sprinkling with the necessary amount of hot water. The fine slaked lime was then sifted through a very fine sieve and the requisite amount mixed with the kerosene as in the case of the limoid. It was found necessary to add 18 additional pounds of sifted lime and even then fully a quart of kerosene remained on top. This made a very thick paste and it seemed impossible to work any more lime in without producing a lumpy mixture. This was diluted with the necessary amount of

water and 2 quarts of sediment remained. It was applied April 1 to 18 trees in the apple orchard of Mr McCoun at Oyster Bay. The emulsion was driven through a force pump for five minutes previous to application. An examination April 15 showed that the trees were slightly sprinkled with lime and that many scale insects were alive, some twigs were missed and there was some washing or else a rather uneven application. July 11 there was very little breeding on the first two trees though on the fourth there were large numbers of young. September 26 the scale was breeding in very large numbers on a number of the trees. This mixture is a difficult one to prepare and our experience with it was certainly not very satisfactory.

General observations

A general observation of the lime-sulfur washes April 15 showed that most of them adhered well even to the smaller apple twigs where the application had been thorough. There was very little evidence of washing. The general results on the experimental trees in the Washingtonville orchard July 13, and also at Oyster Bay were very satisfactory considering the conditions under which the applications were made. This judgment was further substantiated by the trees sprayed by Mr Shons. The latter were practically clean, while the fruit on those he had been unable to treat was well spotted with scale insects and a great many young were to be found on the branches. The same condition obtained September 28. There was only a small amount of breeding on the sprayed trees except here and there where a portion of a limb had been skipped.

Spring applications with lime-sulfur washes in 1905 have been uniformly successful so far as our observations go. The general cooperative work at Glen Cove and vicinity showed that most of the treated trees were almost free from scale, though some of the worst infested ones bore a few living insects. Only occasionally was the pest abundant and then it was limited to a few limbs, evidently skipped. The results on peartrees were fully as satisfactory as those on apple, and in June the scale was well controlled on plum. The few instances where the pest was somewhat abundant on sprayed trees could easily be explained by the rough character of the bark protecting some of the insects. This is particularly gratifying when it is remembered that the work was pushed whenever conditions made spraying at all possible because of the large number of trees needing treatment.

Equally gratifying results were obtained by Mr W. H. Hart in his large orchard at Poughkeepsie, and wherever he was able to spray trees on both sides, each application accompanied by a stiff favorable wind, the pest has been kept under control in a very gratifying manner. The reverse was the case where unfavorable winds prevented treatment from the other side and such bore considerably smaller fruit badly infested by scale. There was also some difficulty in spraying the higher limbs, and in a number of instances Mr Hart has cut the top back with markedly beneficial results. The pest as a consequence has been kept under control at a considerably less expense and trees thus treated were easily recognized because of their larger fruit and more thrifty condition. Some of the others which had not been cut back have rather thin tops with more or less dead branches, showing that the spraying had not been successful at a height of more than 18 or 20 feet from the ground. The general condition of the orchard is much better than a year ago. Mr Hart now believes in thoroughly drenching the infested trees, using a coarse nozzle and he employs hand pumps in preference to power outfits because of the lightness and mobility of the apparatus.

The results obtained by Mr L. L. Morrell at Kinderhook are equally gratifying and the condition of his orchard is much better than a year ago. A Bartlett pear orchard which was severely injured in 1903 and in bad condition in 1904 has made a very gratifying growth during the past season. It is extremely interesting to note that trees sprayed by Mr Morrell with a lime-sulfur-soda wash prepared entirely with cold water, which does not give satisfaction so far as deep brick-red color and vigor of reaction is concerned, were just as free from scale or almost as much so as others sprayed with the regular steam-boiled lime-sulfur wash. We much prefer to adhere to the original recommendation and advise preparing this wash, if it is to be employed, with several pails of hot water to promote a vigorous reaction at the outset. August 10 we had the pleasure of looking over an infested orchard in the central part of the State which had been thoroughly sprayed with a lime-sulfur wash in the spring of 1904 and again in 1905. A specially thorough treatment was given in hopes that the pest could be exterminated, as the infested trees were surrounded by valuable and extensive orchards. The results were exceedingly gratifying and almost no traces of living scale were found on the trees.

Summary of experiments

The results so far as killing the scale is concerned are markedly similar in the case of all lime-sulfur washes employed excepting numbers 7 and 8 where no heat of any kind was allowed to aid in effecting a combination between the lime and sulfur. The general behavior of the washes coupled with experience therewith in previous years leads us to regard formula 1, calling for 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water boiled at least 30 minutes, as of at least equal value to any other fire or steam boiled wash. Formula 2 calling for a little more lime and sulfur was not enough better to warrant the increased amount of material. Formula 6 consisting of 15 pounds each of lime and sulfur to 50 gallons of water gave excellent results, yet previous experience leads us to believe some excess of lime is preferable on several accounts. We therefore continue our recommendation of formula 1 as being among the best of the lime-sulfur washes.

The so called unboiled washes depend upon chemical heat to bring about a combination, and of these formula 3 composed of 20 pounds of lime, 15 of sulfur and 10 pounds of sal soda to 50 gallons of water gave as good results as any similar combination, though more of the soda may be used as called for by formula 4. The lime-sulfur-sal soda wash requires a little care in preparation but after some experience the general results are much more satisfactory so far as chemical behavior and combination is concerned, than is the case with other unboiled or chemically boiled washes we have employed, and as stated above it holds its own in destroying the scale. It requires a minimum amount of hot water to secure a very satisfactory prolonged chemical action. Experience with this wash shows that it can be prepared without any hot water but unless the lime be of very superior quality we believe this to be inadvisable. Formula 5 requiring 30 pounds of lime and 15 pounds of sulfur to 50 gallons of water depends upon the heat generated by the large amount of lime to bring about a satisfactory combination between the sulfur and the lime. The action as noted is violent though of short duration and generally speaking the combination is not nearly so satisfactory as that obtained where sal soda is employed, and the wash itself is not so easy to handle.

Experience with a very fine amorphous sulfur and carefully slaked lime mixed together after the latter had cooled showed that this combination was practically of no value and further discussion

thereof is unnecessary. Formulas 9 and 10, making 20 and 25% kerosene limoid washes, were tested under several conditions and generally speaking the results were not equal to those obtained with lime-sulfur washes, though there is no doubt but that a certain amount of scale was destroyed by the application. The general results were disappointing even in the hands of other persons where the treatment was said to be exceptionally thorough.

NOTES FOR THE YEAR

The following brief accounts relate to some of the more interesting species observed during the season, and are grouped as heretofore under appropriate heads.

Fruit tree insects

Codling moth (*Carpocapsa pomonella* Linn.). This species is well known as the apple worm and is more or less abundant from year to year. The season of 1905 has been marked by considerable injury in different sections of the State, which was further emphasized by the scarcity and high price of apples. The second brood of this pest appears to have caused the greater part of the damage, particularly in the Hudson valley. Some growers, thinking the pest was rather scarce, did not spray at all and as a consequence suffered greatly where others, making the usual applications but not expecting a second brood, were injured to a considerable extent. This is only another instance emphasizing the necessity of constant watchfulness if one would escape severe losses through insect depredations.

Apple maggot (*Rhagoletis pomonella* Walsh). This species is a very common and destructive pest of early apples, particularly sweet varieties in New England. It is only occasionally brought to notice in this State. Mr C. H. Stuart of Newark, writing August 8, states that this insect was very numerous in early fruit, it being so abundant that he was unable to find a sound early apple. Mr W. H. Hart of Poughkeepsie, a large fruit grower, also called our attention to the work of this species, stating that in his experience it was much more abundant and injurious in sheltered hollows than on side hills or other places where there is presumably more air. This species is a somewhat local form and it is very probable that it is affected to a considerable extent by wind currents, since it appears to exhibit a marked tendency to assemble in sheltered places.

Rose beetle (*Macrodactylus subspinosus* Fabr.). This common, well known pest of roses in particular, and a considerable number of other trees and plants whenever the insects are excessively abundant, is more or less numerous from year to year in certain favored breeding areas where the soil is almost always of a sandy nature. Reports of unusual abundance and corresponding injury by this species have been received from Staten Island, Grahamsville and the vicinity of Rochester, N. Y. The insects appear in swarms and not only attack rosebushes but extend their depredations to the foliage of appletrees, even eating into the young fruit at Rochester. At Grahamsville the insects swarmed on fruit trees, displaying a marked preference for plum, the foliage of which they completely skeletonized.

This insect is a very difficult one to control and owing to the fact that its favorite breeding grounds are usually in sandy, comparatively valueless land, the cost of plowing the same and destroying the insects thereby would amount to more than the loss incident to their ravages. The beetles are extremely resistant to insecticides, though Professor Webster found that a whale oil soap solution, 1 pound to 2 gallons of water, was fairly effective in destroying the pests, still it is liable to cause more or less injury to the foliage. Dusting the plants with land plaster, ashes etc. may afford some relief and highly valued small trees or shrubs might be protected by mosquito netting. There is a bare possibility that thorough spraying with arsenate of lead, particularly if it was used in bordeaux mixture and a very large proportion of poison employed, would afford a certain amount of protection and perhaps result in the destruction of some beetles. Experience with other beetles leads us to believe that the relief, if any is obtained, will be as much from the beetles disliking the foliage as their being destroyed by the poison thereon.

Scurfy scale (*Chionaspis furfura* Fitch). This species is more or less prevalent in most sections of the State though rarely abundant enough to cause much injury. The seasons of 1904 and 1905 appear to have been marked by an unusual multiplication and corresponding injury, particularly in Dutchess county, where this scale insect has been abnormally abundant and quite destructive. It can be controlled as has been repeatedly pointed out by thorough spraying with a contact insecticide about the latter part of May or early in June, preferably selecting the time just after the majority of the young have appeared and before they have covered themselves to any extent with the protecting scale.

Grass and grain insects

White grubs (*Lachnosterna* species). White grubs of the May or June beetle are well known and are more or less abundant from year to year, though the insects have a life cycle extending over three years and a corresponding fluctuation in injuries has been observed. This season appears to be one when the grubs were unusually destructive, as reports of serious damage have been received from several sections of the State and one at least from an adjacent state.

The life history of this species may be summarized briefly as follows: Eggs laid by the parent beetles in loose soil hatch about a month later, the grubs slowly increasing in size for at least two years and from the middle of June till the middle of September of the second or third year, earthen cells are constructed by the beetles, in which the transformation to the pupa occurs and the adults appear the following spring.

The rather serious injuries to grass lands last year renders it very probable, in view of the above given life cycle, that the beetles will be unusually numerous next summer. This suggests the idea that in sections where these pests are unusually abundant and injurious it might be advisable to so plan farming operations as to plow under the majority of the grass lands to be devoted the next two or three years to crops liable to injury by these pests, the year following the abundance of the beetles; namely, in 1907. This procedure if followed by a fair amount of cultivation should result in the destruction of many young grubs, as they are presumably less able to withstand adversity during their early existence than later in life.

The subterranean habits of these pests render their control somewhat difficult. There is hardly a more effective and satisfactory method of checking them in gardens, strawberry beds and similar places, than by digging them out as soon as their presence is indicated by the poor condition of affected plants. Repetition of such trouble can be guarded against to a great extent by planting recently plowed grass lands infested by these grubs with crops not affected by them. Neither of these methods can be employed on lawns, where occasionally considerable injury is inflicted. The grubs can be killed in these latter situations by liberal applications of kerosene emulsion, the standard formula diluted with about six parts of water. This treatment should either be followed by a copious watering or be made just before a good rain. The idea is that the water following the insecticide will wash it

down and bring it into contact with the grubs. A successful treatment of this character should result in destroying these insects within a few days.

Saddle-back caterpillar (*Sibine stimulea* Clem.). This slug caterpillar about an inch long may be recognized at once by the light green "saddle cloth" thrown over a chocolate-brown body, both the "saddle" and the "saddle cloth" being margined with white. It is somewhat flattened in shape and bears four conspicuous spiny processes, two near each end and a number of spiny tubercles at each extremity and along the margin of the body. Ordinarily this larva is rare, and we were somewhat surprised to receive a communication in September from Mr F. R. Calkins of Ossining to the effect that the larvae were abundant on his corn and devouring the leaves very rapidly. This species is a general feeder, having been recorded on such diverse plants as apple, cherry, rose, raspberry, currant, chestnut, oak, grape, sumac and beet. This caterpillar is also interesting because of its urticating powers. Mr Calkins states that he was severely stung by a larva. It is therefore necessary to handle the caterpillars with caution. This species when at all abundant can be easily controlled by timely spraying with an arsenical poison.

Stalk borer (*Papaipema nitela* Guen.). This stalk borer is commonly reported as affecting a number of thick stalked plants, especially corn, potatoes, tomatoes and sunflowers. The latter part of June we received a report, accompanied by specimens, of this larva working in the stems of scarlet runner beans, and only a few days before we removed a nearly full grown caterpillar from the succulent tip of a raspberry shoot.

Spittle insects (*Philaenus lineatus* Linn. and *P. spumarius* Linn.). Conspicuous frothy masses of spittle on grass were unusually abundant in different sections of the State and have attracted a corresponding amount of notice. The two common species upon grasses in New England, according to Professor Fernald, are those above named and it is very probable that the young of these two forms produced most of the spittle masses.

These little insects are very peculiar and possess marked characteristics. The eggs are said to be laid in the stems of plants in the autumn, remaining unhatched until the spring. The young establish themselves on various grasses usually at the joint, and begin drawing the juices therefrom. A clear liquid is extruded from the posterior extremity and this is beaten into a froth by the insect extending the tip of its abdomen and drawing bubble after

bubble of air into the fluid with its spoon-shaped extremity. This is continued till the little spittle insect is completely enveloped with a mass of froth which undoubtedly protects its soft tender body from the drying atmosphere and is probably of some service in warding off natural enemies, though certain wasps are known to search out these frog hoppers, taking them from their slimy surroundings for the purpose of provisioning their nests.

The general appearance of a spittle insect is easily ascertained by parting the frothy matter, when a stout, blunt headed, pale greenish or straw-colored hopper less than $\frac{1}{4}$ inch long is revealed. The parents differ from the young only in being slightly larger, of a pale green or brown color and with well developed wing covers.

The injury to plants infested is directly proportional to the amount of sap withdrawn, and while these insects are occasionally quite abundant the damage is rarely serious. There is no practical method of controlling them in grass lands because the expense would amount to more than the value of the crop.

Shade tree insects

White marked tussock moth (*Hemerocampa leucostigma* Abb. & Sm.). This well known insect more frequently comes to attention because of its depredations on shade and other trees within the confines of the city than on account of injuries inflicted on fruit trees. It has been unusually destructive in a number of our principal cities, defoliating thousands of trees in Buffalo, Lockport, Geneva, Rochester, Syracuse, Utica and Brooklyn and undoubtedly causing more or less injury in some other cities and villages. This species occasionally produces a partial second brood in the latitude of Albany, Rochester and Buffalo, though our observations show that in these cities the number of caterpillars appearing late in the summer are so very few that they may be ignored as a rule. The devastations of this pest are more or less periodical, being governed largely by the activity of its numerous natural enemies. The caterpillar succumbs readily to timely application of arsenical poisons and the conspicuous white egg masses deposited upon the flimsy cocoons are very easily removed from infested trees. This species can be controlled with so little difficulty that we must attribute the stripping of so many shade trees to indifference or neglect.

Fall webworm (*Hyphantria textor* Harr.). This very common leaf feeder well known as a pest of fruit, shade and forest trees, may be easily recognized by its large filmy white nests or tents inclosing the foliage on the tips of limbs. The

leaves are skeletonized soon after being covered with the web, and turning brown give an infested tree a very unsightly and characteristic appearance. This pest causes more or less injury from year to year and the past season has been marked by serious depredations in certain sections of the State. It has caused considerable injury in woodlands about Angola, Erie co., and its nests have been more or less prevalent in apple orchards of the fruit-growing section in western New York. The injury in the latter has not been serious because most of the trees receive enough care to prevent great damage by any leaf feeder. The ordinary spraying practised so generally by progressive fruit growers as a rule keeps this pest under and it is only occasionally that a supplemental application must be made or the nests cut from the trees and the inhabitants destroyed.

Elm leaf beetle (*Galerucella luteola* Müll). This species continues to be more or less destructive in the Hudson valley, and were it not for the systematic annual spraying with arsenical poisons in Albany, the elms, particularly the European species, would be seriously injured every year. Observations about Mount Vernon and Tarrytown, N. Y. showed that many of the elms had been somewhat seriously damaged by this pest and the same is true of Oyster Bay. This pest was particularly destructive at Ossining, the beetles being so abundant as to badly injure the foliage before the grubs appeared. This pest

is generally distributed throughout Glens Falls according to Mr C. L. Williams, though not very destructive except to certain European elms.

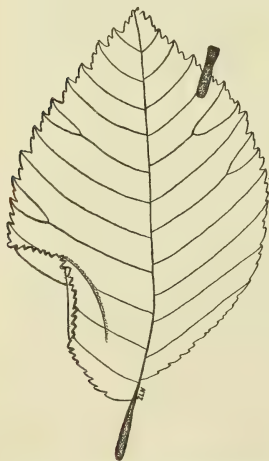


Fig. 9 Case of European elm case-bearer on leaf, much enlarged (Original)

European elm case-bearer (*Coleophora limosipennella* Dup.). This miner is easily recognized as a case-bearer because of the peculiar habit the larva has of carrying about a cylindric light brown cigar-shaped case in which it lives. It has the same habits so far as known as the allied cigar case-bearer, *Coleophora fletcherella* Fern. The destructive work of this species has been evident for several years in Brooklyn parks, and investigations last summer disclosed the fact that it was well established at Oyster Bay, where it was about as injurious as the elm leaf beetle, *Galerucella*

luteola Müll. The two species were abundant enough, so that the foliage in certain portions of the village was badly marked. The general result of injury by these forms is somewhat similar though easily separable. The areas mined by the case-bearer are markedly rectangular, being bounded on either side as a rule by a parallel vein and extending rather evenly for some distance from the central feeding hole which is easily seen when looking up toward a bright sky. The



Fig. 10. Adult of European elm case-bearer (Original)

eroded, semitransparent, skeletonized areas produced by elm leaf beetle larvae are at once recognized by their greater irregularity, the lack of the central feeding orifice and the fact that there is no mining of the foliage. This species, like the common cigar case-bearer on our fruit trees, should be easily controlled by early and thorough spraying with an arsenical poison, making the application at the time the leaves begin to appear.

Cottony maple scale (*Pulvinaria innumerabilis* (Rathv.)). This species was observed in some numbers on the lower limbs of a soft maple at Glen Cove and it has been reported as unusually abundant in St Lawrence county. It is by far the more common insect pest covered with woolly matter, occurring on maple trees, particularly on Long Island where it is likely to cause more or less injury from year to year. It can be controlled by thorough spraying in midsummer with a kerosene emulsion, using about 10 to 12% of oil. Winter treatment with the kerosene emulsion diluted with three parts of water, or a whale oil soap solution, 1 pound to a gallon, has been found very effective by Mr S. Arthur Johnson in Denver, Col. This latter method results in a great saving, as one fourth the amount of the insecticide necessary to spray a tree in foliage is sufficient to cover it after the leaves have fallen.



Fig. 11 Cottony maple scale, much enlarged (Original)

Maple Phenacoccus (*Phenacoccus acericola* King). This, ordinarily a rare insect, has attracted more attention in recent years on account of its abundance on sugar maples in Albany and vicinity. The first general outbreak which came to

our notice occurred in 1901, at which time a number of hard maples in Albany, N. Y. and Worcester and Springfield, Mass. were very badly infested. This species appears to have been somewhat abundant and destructive the past summer to the hard maples at Mount Vernon, N. Y. It may be readily distinguished from the more common cottony maple scale, *Pulvinaria innumeralis* Rathv., and its allies by the presence of the woolly females on the under surface of the foliage and the numerous minute young on the bark, particularly that of the larger limbs and trunk. There is another maple leaf scale, *Pulvinaria acericola* Walsh & Riley, which occurs on the underside of maple foliage. This form may be at once recognized, however, by the conspicuous brown scale so characteristic of the cottony maple scale. This maple leaf scale so far as known is by no means common though it is very probable that it has been confused with the more prevalent destructive cottony maple scale. Neither of these *Pulvinarias* occur in white felted masses on the bark of the larger limbs and trunk, which is very characteristic of the maple *Phenacoccus*. This species should be controlled as well as the cottony maple scale, and it is probable that both respond equally well to thorough and timely spraying with a 10 or 12% kerosene emulsion or a strong whale oil soap solution.

Woolly maple leaf aphid (*Pemphigus acerifolii* Riley). This species is rarely abundant enough in New York State to attract popular notice. It was so numerous during the summer of 1905 that a number of inquiries accompanied by soft maple leaves almost covered with these woolly plant lice were received from different sections of the State. Complaints of this character came from Cornwall, Menands, and what was presumably this species gave rise to a report from Floral Park. This aphid may be easily recognized by the large amount of woolly matter, which is sometimes nearly as long as the insect itself. It may be separated from the closely allied *Pemphigus aceris* Monell, which lives on the underside of hard maple limbs, by the antennae reaching only to the wing insertion, whereas in the last named the fourth joint extends to the base of the wings. These plant lice usually desert the trees early in June and as a rule remedial measures are unnecessary.

Forest tree insects

Black walnut worm (*Datana integerrima* Grote & Rob.). The work of this species on black walnut and butternut

trees is more or less apparent from year to year, particularly in the western part of the State. This species was unusually abundant and destructive in the vicinity of Westfield, N. Y., stripping entire trees of their leaves and devouring a considerable proportion of the foliage of others. The caterpillars were so numerous that late in October masses of cast skins were still evident on black walnut trees. It is probable that this species is responsible for serious depredations on black walnuts at Angola. Similar injury to walnut trees at Stanley was reported by Mr J. Jay Barden.

Hickory gall aphid (*Phylloxera caryaecaulis* Fitch). Young galls of this species may be met with in early June. They then vary from the size of a pea to that of a small marble, are irregularly spheroid, being usually prolonged at the juncture with the midrib or petiole, and with a more or less distinct, somewhat irregular ventral orifice which is completely closed. The galls at this time vary in color from pale greenish to a bright pink, those attached to the mid. vein of the leaves showing slightly on the upper surface. Many of the structures are so near each other that they fuse and each contains a central cavity with a stem-mother and numerous young plant lice evidently just hatched from the egg. Later these deformations become green or rosy and as they increase in age the young plant lice become more abundant, so that an examination during the later period of growth may show the inner surface literally covered with numerous young pale green plant lice, and somewhere in the cavity the much larger, stouter form of the parent insect. Later the green distorted tissues die, turn black, leaving an ugly shrunken mass. This gall insect is one of our common species and is sometimes so abundant as to cause considerable injury to hickory trees.

The life history of this insect based upon our own observations and those of Mr Pergande upon a closely allied species, is substantially as follows: The green galls begin to develop with the unfolding foliage and are caused by an abnormal growth of tissue around the stem-mother, which latter hatches from a winter egg about the time the young leaves appear. The increase in tissue is very rapid and soon the insect is inclosed in a globular cavity. An examination shows the latter to be inhabited by a single stem-mother or parent insect and numerous young. The galls become fully developed in the course of a few weeks and allow winged individuals to escape. These latter may be observed upon all kinds of vegetation in the neighborhood of the tree and eventually produce the generation which deposits on the trees eggs as mentioned above.

These latter remain quiescent nearly 10 months in the year and it is in this stage that we have the best chance of controlling the insect.

It is possible that thorough spraying with kerosene emulsion or a whale oil soap solution in early spring before there was the slightest signs of hickory foliage would result in the destruction of many of the winter eggs. It is very probable that a treatment with a standard lime-sulfur wash would be much more effective than kerosene emulsion or a whale oil soap solution, particularly if it was applied very thickly, because this material possesses active insecticidal properties for some time, and even if it was not strong enough to kill the eggs at the outset, something which is rather doubtful, it might possibly destroy the young plant lice upon hatching and thus prevent further injury. Unfortunately this method of control can be applied in a practical way only to small trees as a rule and it should be supplemented where possible by cutting off the green galls and destroying them before any of the insects escape, since this species appears to be somewhat local in its work.

Spindle-shaped elm gall (*Pemphigus ulmifusus* Walsh).

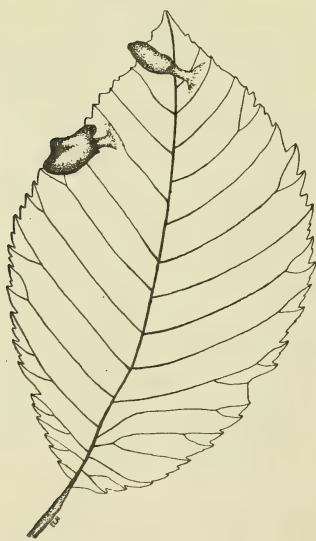


Fig. 12 Spindle shaped elm galls on leaf, much enlarged (Original)

Specimens of this rare gall were received from Mr C. L. Williams of Glens Falls, N. Y. July 7, 1905. The galls are confined to the upper surface of the leaf and are usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch from its free edge, originating in a clear area between the veins. The galls range in size from $\frac{1}{4}$ to $\frac{5}{8}$ of an inch in length and have a very narrow neck with a widely dilated body. The specimens transmitted vary in color from pale yellowish white to dark brown. The latter appear to have attained maturity and several at least had ruptured near the base, thus allowing the occupants to escape. An examination of several of the green galls shows that the walls are moderately thick, each inhabited by a solitary

stout, wingless, purplish black plant louse. There were no signs of rapid multiplication.

Eulecanium quercifex Fitch. Young chestnut shoots badly infested with this scale insect, kindly identified through the courtesy of Dr Howard, were received in early June from Miss Eliza S. Blunt of New Russia, N. Y. with the statement that the trouble



Fig. 13 *Eulecanium quercifex*, on chestnut, two scales infested with *Cordyceps pistillariaeformis*, enlarged (Original)

was very prevalent on all the young chestnut growth in that locality and about Bolton Landing, Lake George. A most interesting feature of the outbreak was the abundance of a fungous disease, kindly identified by State Botanist Peck as *Cordyceps pistillariaeformis* B. & Br. This fungus was so prevalent that nearly half of the scale insects were affected thereby. Its peculiar characteristic capitate fruiting stems about $\frac{3}{16}$ inch high made the detection of infested scales very easy. The unfortunate individuals appeared to be permeated by this growth and the entire surface changed thereby to an ashy gray color.

This scale insect varies widely in color, the old ones being a dark brown with irregular, fuscous markings, sometimes approaching the appearance of *Eulecanium nigrofasciatum* Perg. to some extent, while the young ones are lighter and in a few instances bright orange. A few partly grown young were observed and also several males just about to escape. A small, greenish, black headed caterpillar was noticed on one of the twigs. It had evidently been feeding upon the scale insects, and may have been the larva of *Laetilia coccidivora* Comst. The fungus attack and the work of the Lepidopterous larva were so

evident that it is doubtful if the scale will inflict much injury, in spite of its being so generally present.

Miscellaneous

Caucasian bee. The United States Bureau of Entomology has given considerable attention to the honeybee and its products, making a special effort to obtain more desirable strains. Through its efforts the Caucasian bee has become established in this country, and in November 1904 the Entomologist made application for a queen for the purpose of making comparative tests. This queen together with a number of workers was received in excellent condition June 10, 1905 and put in the custody of Mr Robert Wilke of 210 Livingston av. Albany, N. Y. with instructions to make a careful comparison between this bee and the more common form. The following statements were drafted from a report submitted by him after the close of the active season.

He states that the bees, which were a peculiar brownish black color, were immediately given two frames of hatching hybrids in an eight frame Langstroth hive. The entrance was then closed with wire netting to keep out robber bees. June 12 he gave more capped brood and honey, and on examining on the 19th he found a fair number of bees, the queen having laid between six and ten thousand eggs. He gave the bees their first flight at this time and observed that they were active on pollen. June 24 the colony was picking up strength and there were a fair number of field bees. July 11 young brood was emerging, the bees were active and there was plenty of brace comb. He added two frames to the six, making eight in all and observed that there was plenty of honey. All the brace comb was cut out on the 18th when the bees were beginning to work on the super. They then had brood in eight frames. August 8 preparations to swarm were in progress. The super was taken off, the swarm cast and it was then put back. The next day the bees swarmed again and returned, the hive was again examined and a number of long, slender queen cells removed. These latter presented a marked difference in construction from those of any other that has come under his observation, since they were often 2 inches in length and quite slender and little wax was used in covering the walls. The bees also exhibited a marked tendency to build these cells on the bottom of the comb. August 31 the bees swarmed and returned. They were gentle but slow on the super. October 15 the bees had not finished a super of 24 pounds.

They were quiet and healthy and had broods in all stages, also eggs. December 2 they were put in the cellar for the winter.

It does not appear to Mr Wilke that the bees showed to best advantage, since they were received too late in the season to do much on honey, yet they were rather slow in building up even when mild weather favored them. Respecting comparative gentleness he is not certain, as all of his bees with the exception of one strain were somewhat more vicious than usual.

Large carpenter ant (*Camponotus herculeanus* Linn.). This large, black ant is frequently observed in small numbers about dwellings and occurs commonly in dead stumps or trunks in nature. It is a well known wood borer and occasionally excavates large cavities even in living trees. Its work is particularly noticeable in the Adirondacks, where spruce and balsam trunks are sometimes badly riddled by its operations.

Our attention was called to the work of this ant in dwellings by the receipt of a communication July 14 from Mr C. C. Merriam of Lyons Falls. He stated that they first observed a heap of sawdust in the attic of their recently constructed house, and on investigation found that this ant was working in the rafters. The insects had fairly riddled about 3 feet of two 2 inch spruce rafters lying side by side. The injury was of such a nature as to raise a serious question as to the ultimate effect upon the building. These insects rarely carry their depredations to the point where the integrity of a structure is threatened, though there is no reason why considerable damage might not be inflicted wherever the pests are abundant, since tree trunks may be so thoroughly tunneled by this species that they break readily in a high wind. It would probably be advisable, in case a few timbers in a dwelling are somewhat injured and contain numerous ants, to either remove them and replace with some wood less likely to be attractive to the pests, or else adopt some active measure for the destruction of the ants. The insects in infested timbers should be destroyed so far as possible, and the cavities might be filled with a creosote or tar preparation or even a thin plaster of paris, with a view of preventing further depredations. Blowing insect powder into the cavities or the injection of carbon bisulfid will drive out or destroy many of the ants. There is a possibility that they could be attracted to poisoned sweets or destroyed in large numbers by placing a syrup, made by dissolving borax and sugar in boiling water, in the vicinity of their haunts.

Green-headed horsefly (*Tabanus lineola* Fabr.). This species was very abundant and annoying to horses about

Long Island, N. Y. being particularly numerous in the vicinity of the salt marshes. It assembles in large numbers in the horse sheds



Fig. 14 Green-headed horsefly, much enlarged (Original)

and is a serious annoyance to animals tied thereunder. A significant fact in connection with this species is the statement by several reliable observers to the effect that a few years ago when considerable oiling was done for the sup-

pression of mosquitos, these pests were much less abundant than during the last year or two, when ditching operations have been relied upon more largely for mosquito control. This latter seems to have had no effect upon the horseflies, as was attested by their abundance about the salt marshes last July while mosquitos were conspicuous because of their absence.

These observations are particularly gratifying as they bear out the results obtained in Russia by Professor Porchinski, who found that the adults were destroyed if there was an oily film on forest pools frequented by them. Horseflies or Tabanidae have a habit of repeatedly drinking from favorite damp, woodland pools and in that way may come in contact with the oil and perish. Similar results on a smaller scale were obtained in this country by Dr Howard. The application of oil to pools is now generally regarded as merely a temporary expedient for checking the multiplication of mosquitos, but it seems to be of considerable value in destroying horseflies and might be employed to advantage wherever these insects are unusually numerous and annoying. The only essential is that there be a film of oil on the pools when the horseflies are abundant, something self-evident to any resident. The more pools treated the greater the chances of success and it is very probable that a little observation would result in finding the pools most favored by these insects and thus result in a great saving in controlling the pest without materially diminishing the effectiveness of the method.

Giant water bug (*Belostoma americanum* Leidy). A specimen of this gigantic brown water bug was received July 5

from Mr E. J. Casler, Hoffmeister, Hamilton co., N. Y., with the statement that it was attached to the back of a trout weighing half a pound. This giant water bug is a well known enemy of fishes, preying as a rule on the smaller forms and when abundant it may cause considerable injury by destroying large numbers of fish. The full grown insect is nearly $2\frac{1}{2}$ inches long, almost an inch in breadth and of a nearly uniform brown color. These bugs fly readily, which is often a necessity, as pools inhabited by them may dry up completely, and at such times they may be attracted to electric lights in large numbers. This has led to the popular designation of electric light bug. These insects with their inconspicuous brownish coloring probably have very similar habits to an enormous tropical American species measuring some 4 inches long. These latter are said to lurk in quiet pools, darting out suddenly upon an unsuspecting victim, which is grasped with the strong clasping forelegs and cruelly wounded, when the powerful beak is plunged deep into the flesh. A copious supply of saliva is injected into the wound and undoubtedly hastens the paralysis so soon following an attack.

THE SHADE TREE PROBLEM IN NEW YORK STATE

The value of a moderate number of trees along our streets is questioned by no one, though judging from conditions prevalent in many cities and villages of the State there is a distinct understanding on the part of abutting landowners that the trees after being set must look out for themselves. The employees of telephone and telegraph companies lop off limbs or heads with very little regard to the injury inflicted, while ditches, run in our streets for water, sewer, gas pipes and other purposes, destroy many of the feeding roots. Electric currents from the wires overhead and gas escaping from leaky pipes underground, all threaten the trees with destruction. Waterproof concrete or other paving renders a thrifty growth still more difficult, and the trees are not helped by the careless driver who allows his horse to gnaw the trunks while no one protests. Bacterial and fungous diseases and injurious insects of one kind or another frequently multiply without check and either lower the vitality of the tree, seriously deform it or accomplish its destruction.

Very few have an adequate idea of the value of shade trees. Some prize a few highly while the majority are more or less indifferent. Shade trees are valuable assets and add greatly to the

desirability of adjacent property. There should as a rule be in the neighborhood of 200 trees to a mile of street, which would give rows on both sides with the trees in each about 50 feet apart. Col. William Fox of the State Forest Preserve estimates that there should be 196 trees a mile. None of these could be replaced for less than \$10 apiece and in not a few instances 10 times the amount would be inadequate to secure their duplication. Furthermore the supply is very limited and can not be renewed under 25 to 50 years. Taking the above figures as a basis it is interesting to estimate the total amount of this form of wealth. The city of New York, with over 3200 miles of street, has shade trees valued at the enormous sum of \$6,475,100. There is an entomologist connected with the department of public parks in the borough of Manhattan and he, with a force of men, does all that is possible with the means at his command to protect the trees in that large area. The cities of Albany and Troy, each with about 100 miles of street and shade trees therein valued at nearly \$200,000, were compelled by the ravages of the elm leaf beetle in the early 90's to adopt some measure for the protection of their elms. Experience is costly, and before the public really comprehended the danger some 2500 trees in the two cities were ruined or dead, a loss of at least \$25,000 and probably of double or treble that amount. The result has been that the city of Albany as a municipality has in the last few years expended annually with most beneficial results from \$1600 to about \$2000 in protecting its trees from this pest, while the same ends have been obtained in Troy through private enterprise. It is estimated that all the cities of the State have 6831.9 miles of street giving us a total valuation for the trees therein of \$12,590,524. This is by no means the whole, as many beautiful villages throughout the State owe much of their attractiveness and prosperity to the rows of stately trees adorning their streets. Our incorporated villages have at least 2800 miles of street, and using the same estimate as before we have a total of \$5,511,324, representing the value of street trees in the villages. There are in addition to the above, according to estimates by the State Engineer, 73,746 miles of country road, most of which might easily be bordered here and there with street trees. A pertinent suggestion was made a few years ago by Colonel Fox, who advocated the setting of trees beside the newly built State roads, stating that only 2% additional would be necessary for this purpose.

The above gives some idea of the general conditions of our shade trees and of the large values represented by them. The season of 1905 was characterized by very severe injury to shade trees by tussock moth caterpillars. This was particularly true in the cities of Buffalo, Rochester, Geneva, Syracuse and Utica and many thousands of beautiful shade trees adorning their streets and those of other cities and villages were partially or entirely defoliated by this pest, which is more or less injurious from year to year. This has been specially marked in the city of Buffalo, where the horse-chestnuts at least are far from being models and some of the other shade trees are in very poor condition. These depredations resulted in a great many newspaper notices, and beyond a brief characterization of the injury nothing more comprehensive was urged than the somewhat makeshift recommendation that the conspicuous egg masses be removed through the efforts of school children or by general cooperation. Rochester undertook this work and appropriated \$500 for the purpose of paying school children so much a quart for the egg masses. Interest was further stimulated by offering prizes to a few obtaining the largest number. Newspaper items in November state that the plan has not been entirely successful, only \$7 of the \$500 having been claimed by the children. There is no doubt but what the tussock moth can be controlled by collecting egg masses and where a large amount of enthusiasm and push is behind the effort it is possible to have this done by school children, as was demonstrated in Rochester some 10 years ago. This method of combating an insect pest is open to several objections. In the first place it is sporadic in nature and rarely becomes effective till public opinion is aroused, and this latter does not usually occur till after the trees have suffered serious injury and in some cases not even then. The value represented by our shade trees leads us to question the wisdom of exposing them to serious injury for the sake of saving a very small percentage of their value. It seems as though the time is ripe to make more comprehensive plans for the protection of our trees, particularly as there are other insects to be checked beside the one mentioned above, and unfortunately some of these are much more difficult to control. The elm leaf beetle and the associated elm bark louse are both exceedingly destructive to elms in the Hudson valley and are likely to cause equally great injury in other cities and villages in the State. The soft maples [pl. 1] in and about New York city are affected by a very pernicious borer,

the leopard moth, and the cottony maple scale is a dangerous pest of soft maples in that section. There is in addition a soft brown scale which is fast becoming a serious enemy to both soft and hard maples in the Hudson valley and presumably in other sections of the State. Many beautiful white birches have been killed by a destructive borer [pl. 2]. The situation is rendered much more grave by the slow and sure spread of the now thoroughly established and almost omnivorous gipsy moth in Massachusetts and its able and hardly less baneful associate, the brown tail moth. The former has made its way about 30 miles west of Boston and the latter has already invaded the Connecticut valley. Both are quite injurious to shade trees, the brown tail moth showing a decided fondness for maples. There are minor insect enemies in addition to those mentioned above. Bacterial and fungous diseases are also insidious foes and should be checked wherever possible.

It is a short-sighted policy that allows this vast wealth of our municipalities and villages to be destroyed for the want of a little protection, and the present seems a most fitting time to urge the adoption of more comprehensive measures to safeguard the welfare of our trees. Every city of 50,000 or more should make provision for the adequate care of its shade trees by putting them under the control of a properly qualified forester or entomologist connected with either the park or street department. Most villages would also find it advantageous to make some provision for the welfare of their shade trees, even though it is impossible to place their care in the hands of a specially qualified person. It is not necessary that one charged with this work be a college graduate or a professional entomologist. A practical knowledge of trees and methods of protecting them from insect depredations is all that should be insisted upon. Such a man's first duty should be to keep the shade and park trees in good condition and protect them from fungous diseases and insect ravages. It should also devolve upon him to set out trees wherever needed, and a knowledge of their habits and methods of growth would prove invaluable in selecting those adapted to the various conditions found in every city and village.

The cost of such work is not excessive and in a city of 100,000 inhabitants or thereabouts very much could be accomplished by an annual expenditure of two to three thousand dollars or one to one and one half per cent of the value of the trees, and the benefits resulting therefrom would be beyond computation. There are in

various cities and villages of the State thousands of unsightly, ruined or dead shade trees, the result of a failure to appreciate the possibilities of judicious protection. Even the cutting out of the dead trees and the removal of diseased or rotten limbs would help general appearances very much. Most communities have little conception of the value of shade trees and we wish that every one interested in this work might visit Saratoga Springs or some other village where the trees receive adequate care. These places have their magnificent trees in spite of insect pests and other troubles because they are willing to incur a reasonable expense for their protection. Such results are possible in practically every city and village, and civic pride if not self-interest should lead all citizens to insist upon better protection of their shade trees.

MOSQUITO CONTROL

Mosquito control means immunity from malaria, yellow fever and freedom from hosts of the more common pestiferous forms. It is somewhat costly, though the wisdom of the investment can not be questioned when it is remembered that malaria is more or less prevalent in the North and, according to an authority, "is responsible for more sickness among the white population of the South than any disease to which it is now subject." A recent yellow fever outbreak at New Orleans recalls vividly the disastrous results attending such epidemics in former years and affords a striking illustration of what may be accomplished when scientific measures are vigorously prosecuted. The malady of 1905 was not of a type easily controlled, and its eradication before frosts destroyed the mosquitos demonstrated in our own country the value of the work prosecuted with such notable success in Cuba a few years earlier and adds a most striking page to the abundant evidence, proving that this dangerous enemy of humanity in tropical and subtropical regions is dependent on mosquitos for dissemination. It is only necessary now to enforce quarantine regulations that will render it impossible for the disease-carrying mosquitos of this country to become infected in order to make such outbreaks as that experienced last summer of historic interest only.

Intelligent control presupposes some knowledge of the various forms and their habits. There are between four and five hundred described species in the world. About 50 are known to occur in New York State, though only four years ago but 24 were listed from North America. Closely allied forms may have nearly

identical habits, though in some instances there are wide divergencies. Fortunately the disease carriers rarely fly more than 200 yards or thereabouts, a marked contrast to the troublesome salt marsh mosquito, which has been known to make its way 40 miles or more from its breeding grounds. The eggs of certain species float upon the water, hatch soon, and within 15 or 20 days mosquitos are flying again. Others deposit ova in water or damp places, where they remain unhatched till the following spring. The eggs of some species develop simultaneously, those of others at irregular intervals, due to successive inundations by rain or sea. The wrigglers or larvae are very diverse; a few have no air tubes, others very short ones, some are moderate in length and a few possess extremely attenuated breathing tubes [*see* pl. 3, fig. 1, 2, 3]. This usually large appendage is frequently of great service in identifying species. Certain wrigglers occur only in clear water, others in either clear or foul pools, still others prefer brackish water, and the larvae of one species are remarkable because they live only in the water of the semiaquatic pitcher plants [pl. 6, fig. 2, pl. 7, fig. 1]. Adult mosquitos vary widely; some are brightly marked with yellow and rich browns, many have white banded legs, while the color of others is obscure. Great diversity also obtains in their habits. Some are extremely bloodthirsty and wander long distances in search of victims, others remain close to their breeding places, rarely biting man, and certain forms do not molest him even when their haunts are invaded. The wrigglers or larvae have widely different habits. These conditions would seem to render mosquito control impossible. Such is not the case because the dangerous places are near-by small pools, standing water in other receptacles such as barrels [pl. 5, fig. 1], cisterns and cesspools. The problem is further simplified by the fact that comparatively few species in a locality are annoying.

Our native malarial mosquitos have nearly identical habits. The spotted-winged adults [pl. 4, fig. 2], easily recognized by their resting with the beak and body in a straight line, winter in almost any available shelter. Eggs are deposited on the surface, preferably in grassy or weedy, rather shallow, fresh-water pools [pl. 5, fig. 2]. The very short-tubed wrigglers hatch soon and feed at the surface. The life cycle occupies between three and four weeks and breeding is continued during most of the warm weather. Recently excavated spring pools [pl. 6, fig. 1] appear to be exceptionally attractive to these insects, even though the water surface

is not materially increased by the digging. This was extremely well shown last summer in one locality we had frequently visited in the search of larvae. Before excavations were made mosquito wrigglers were present in very small numbers and sometimes absent. The recent digging changed this remarkably, and newly made water-filled hollows were literally swarming with the wrigglers of both malarial and nonmalarial mosquitos. The connection between excavations and malarial outbreaks has long been recognized, and this observed partiality of mosquitos for waters in such places affords some explanation of why this should be the case, particularly if Italians infected with a mild type of the malady are employed, since when the disease is communicated in this manner it is liable to assume a virulent form in nonimmunes.

The tropical and subtropical yellow fever mosquito has much the same breeding habits as our common rain barrel or house mosquito, though the wrigglers of the two species are very different. Both breed largely in rain barrels, cisterns and similar places, a number of generations being produced during warm weather. The salt marsh mosquito and several of its allies pass the winter as eggs, only a portion hatching with successive rain storms or inundations due to high tides. Thus series of swarms are produced during warm weather. A number of fresh-water species present marked differences from the above, since the eggs hatch in early spring and only one generation is produced. These species are of small importance, though some of their allies breed more or less in early summer and may prove annoying. Another group, known as midsummer mosquitos, is remarkable for its very long-tubed wrigglers. This includes among others the rain barrel mosquito and the little black mosquito. The latter, one of our smaller forms, makes frantic attempts in mid or late summer to get indoors, working through the mesh of ordinary wire screen.

Destruction of mosquitos prevents the dissemination of malaria and yellow fever because they are the only carriers of these diseases. More than this, mosquitos must first become infected before they can convey either of these disorders; consequently the medical man has only to destroy as many mosquitos as possible and then, by screening, prevent others from becoming infected by biting patients and his object is attained. Yellow fever cases are occasionally brought to Havana and, for that matter, to New York and cared for, the only precaution taken being to keep mosquitos away from patients and the results have justified the procedure. It would

hardly be necessary to do even this in New York, since the yellow fever mosquito, *Stegomyia*, does not occur in this latitude; still some precaution is advisable. The slight difference between an abundance of mosquitos with suffering and none with health and comfort is strikingly exemplified in the case of Sea Cliff, L. I., with its elevation of about 100 feet. Owing to the character of the soil there are no favorable near-by breeding places for malarial mosquitos, though attractive springs and pools occur within a quarter of a mile and near by are extensive salt marshes producing millions of mosquitos, yet the village of Sea Cliff is exempt from malaria and never troubled by mosquitos. The former is due to the absence of favorable breeding places within a few hundred yards, and the latter to its comparatively slight elevation. Mosquito control is practical provided the habits of the insects are understood and the troublesome forms recognized. Breeding areas are really very limited and in many cases they can be drained with comparatively slight expense. The salt marsh mosquito, extremely annoying along the coast, does not breed throughout the marshes but is confined to a portion along the upland and extending out a distance of 150 to 250 feet, or in other words limited to parts flooded by high tides and not reached by ordinary ones. This strip contains brackish pools in which the wrigglers mature and escape between high tides or severe storms. None occur in pools containing fish or in association with fiddler crabs. The breeding of this and associated species may be prevented by draining these areas so that no pools will be left from one high tide to another. The state of New Jersey has done much to encourage antimosquito work, which has been ably seconded by local efforts in the Oranges and other communities in that state.

A most striking illustration of the efficacy of this work is that given by Lawrence, L. I., which has amply demonstrated the feasibility of controlling the salt marsh mosquitos by relatively simple and comparatively inexpensive ditching operations. The annual expense is only about \$1000 and the total expenditure on these operations during the past four years does not exceed \$10,000, in spite of the fact that the village is situated upon a narrow neck of land with the extensive salt marsh areas of Jamaica bay to the north and west and large marshes south and east, all producing in former days millions of mosquitos which invaded the village in swarms with every favorable breeze. Some of these marshes extend almost to the center of the village, which is so completely

surrounded that a journey of $2\frac{1}{2}$ miles in almost any direction will bring one to a salt marsh. More unfavorable conditions for mosquito control could hardly be found, and before this work was attempted mosquitos swarmed in the village in May and remained in numbers most of the season. The second year swarms did not invade this territory till June, and last year it was the first of July before they appeared. Our investigations at the end of last July showed that there were practically no mosquitos in the center of the village. It was our privilege to sit on a piazza one evening when conditions were most favorable for mosquito activity. Though it was cloudy with only a little breeze and rather warm, not one appeared. Previous to this antimosquito work it was said that one could not sit on this piazza without being covered by netting, and the owner even went to the trouble of making a framework to hold netting suspended over individual chairs, so that his family and guests could sit in comfort.

This very desirable result has been brought about by a drainage system so planned that the entire length of all ditches will be flushed by every tide. The general practice is to run these ditches within about 200 feet of firm ground and sometimes closer, making them 18 to 24 inches in width, from 2 to 3 feet deep [pl. 8, fig. 2], with main ditches here and there to tidal channels. A few headland ditches are run into the more dangerous swampy areas in baylike extensions of the marsh. Such ditches require no surveying and cost only $1\frac{1}{2}$ cents a running foot. A little experience enables one to lay them out properly and the tides make the determining of levels extremely easy. It was very interesting to compare the conditions between ditched areas and undrained marshes. The former were so free from mosquitos that one could tramp upon them with practical immunity from bites, though occasionally a few mosquitos were seen on one's person. No larvae were found and in fact there were very few places where breeding was possible. Undrained marshes presented a very different condition. Mosquitos swarming in adjacent woodlands made driving very uncomfortable, and when on the marshes one was attended by considerable swarms of vicious biters, even in midday. Here and there breeding pools were literally black with young wrigglers. This contrast between drained and undrained areas would doubtless have been much greater were it not for the fact that our inspection was made during such a dry time that even undrained marshes presented comparatively few favorable breeding places.

Experience at Lawrence has shown that deep ditches with perpendicular sides are far more permanent than shallow ones with sloping sides [see pl. 8-10]. The attempt to slope the bottom of the ditch so that all the water will drain out invariably results in depressions which may become dangerous breeding places and the drainage value of the ditch itself is much lessened. Sloping sides [pl. 10, fig. 2] afford opportunity for the growth of grass and sedges with the result that the ditch soon becomes choked with vegetation. The deep perpendicular ditches described above remain entirely free from vegetable growth, and with a little care in removing sods and drifting matter will last for years. Some dug four years ago [pl. 9, fig. 2] were in perfect condition last July, though the grass growing along the sides overhung and almost hid the ditch from view in places. An area of 25 feet on each side is easily drained by such a ditch. The village now has 40 miles of marsh drains which require more or less attention from three men during most of the open season. They keep the ditches clear, supplementing their work by judicious oiling here and there wherever mosquito larvae are abundant and then have considerable time available for perfecting the system and ditching more distant marshes. Experience showed that a considerable number of salt marsh mosquitos bred on that portion of Jamaica bay northwest of the village were brought in by southwest followed by northeast winds. This led to the extension of ditching operations some 2 miles beyond the village limits. The work in the immediate vicinity of Lawrence was done partly at public expense assisted by contributions from owners benefited, though it was impossible to secure the cooperation of persons owning the distant marshes, which latter were drained entirely at village expense. The existence of such breeding areas is an imposition upon adjacent communities and it is only a question of time before public opinion will demand a law either compelling owners to abate such nuisances or else provide for their suppression at public expense. The money invested by Lawrence in this work, a total of less than \$10,000, has amply justified itself in vastly improved conditions. The village and its vicinity have been entirely freed from breeding places, though occasionally it is subject to late summer invasions by hordes of mosquitos when favorable winds bring them from undrained marshes. Even this will be obviated when the value of the work becomes more generally appreciated and then the cost of the operations will be amply returned in increased land values, to say

nothing of the satisfaction accruing from the absence of these dangerous and annoying pests.

Considerable has been written and said about controlling salt marsh mosquitos by a system of dikes designed to prevent the daily ebb and flow of tides within the protected areas. The great trouble with this system is that it is much more expensive than the simple ditching outlined above, and the problem is further complicated by the very slight fall obtainable. Diking supplemented by considerable filling will undoubtedly prevent breeding over large areas, but the latter is costly and for a term of years at least essential if one would control mosquitos. The Lawrence authorities have experienced more difficulty in preventing breeding in a diked and drained marsh where there was no filling than in open marshes, because it was almost impossible to provide for the prompt drainage of small hollows here and there. Further, the slight fall made it impossible to put drain tile low enough, so that it would be beyond the reach of the plow. The result is that drainage systems behind dikes become almost useless in the course of a few years unless there is a large amount of filling. There is no doubt as to the ultimate value of diking and filling, but this work should be charged to land development rather than to mosquito control.

Draining as outlined above is a comparatively cheap way of eliminating salt marsh mosquitos, and if it be supplemented by judicious filling, oiling and the introduction of fish into breeding pools which can not be drained, the problem is solved. This work also results in a greatly improved crop of salt marsh hay. The migratory habit of the salt marsh mosquito makes it desirable to extend drainage operations over rather large areas, otherwise communities undertaking this warfare may find their efforts partly nullified by swarms coming from more or less distant undrained marshes. We expect shortly that mosquitos originating from adjacent undrained marshes or other breeding places will be regarded as nuisances which may be abated by prescribed legal measures.

The control of fresh-water species including malarial mosquitos is ordinarily less difficult than that of the salt marsh forms, because breeding areas are usually very restricted, in many instances limited to cisterns, water barrels or something of the kind. This fact is well recognized at Lawrence, L. I., the authorities insisting that individuals must look after their domestic mosquitos. As a rule it is the small area and not the large one which causes trouble. The presence of a fresh-water form may be regarded as conclu-

sive evidence of near-by breeding places and should lead to an exhaustive search for the source of the trouble. It must be remembered that mosquitos breed in all manner of places where there is standing water and that it is the easiest thing in the world to overlook a prolific breeding spot.

Compaigh work against mosquitos may be outlined briefly as follows: First, recognize the troublesome species and if possible drain all dangerous breeding areas, supplementing this by judicious filling and oiling and do away with or cover tightly tanks, cisterns, barrels [pl. 5, fig. 1], old bottles, etc. This, supplemented by the introduction in waters uncared for by the above means of gold fish, top minnows, killifish and the like, will result in destroying most of the larvae, particularly if the borders of small undrained pools can be deepened slightly, so that the fish will have access to all parts. These little creatures are voracious feeders on mosquito larvae and can be depended on to keep the pests in check if given a fair opportunity. There is no doubt as to the outcome of judicious efforts to control mosquitos, and we confidently look forward to a time when this will be generally appreciated and the presence of swarms of these insects rightly attributed to indifference or incompetence, rather than to supposedly insuperable obstacles to their eradication. It logically follows that mosquitos must be declared nuisances and adequate provision made for their suppression or control through both private and public agencies.

STUDIES IN CECIDOMYIIDAE

The gall gnats are extremely interesting not only because of the peculiar vegetable malformations produced but also on account of the striking morphologic characters presented, particularly in the high specialized antennae. The galls caused by members of this group are better known than the insects, and as our recent studies of species affecting forest and shade trees in particular have resulted in the rearing of a number of forms previously unknown in the adult, this opportunity is taken of characterizing the various stages of several species, so far as the material secured will permit. The generic references must be considered as provisional only, at present.

Goldenrod leaf gall (*Lasioptera carbonifera* n. sp.). This species produces oval, brown or black, blisterlike galls about $\frac{3}{16}$ of an inch long on goldenrod. It was described by Osten Sacken from the gall, was referred to the genus *Cecidomyia*, and so far as we can learn the adults which were bred from this species in some numbers the latter part of June have remained uncharacterized. This interesting form is described below.

Female. The jet-black, coarsely granulate eyes are conspicuous, fused dorsally and bordered posteriorly with a narrow line of white scales or scalelike hairs. The short, thick, light brown moniliform antennae composed of 14 segments, arise between the eyes and are about one fifth as long as the insect. The individual segments are subglobular with a somewhat irregular row of well marked setigerous elevations near the apical fourth, each bearing a hair as long or longer than the segment, other portions thickly ornamented with minute, chitinous points and with very irregular clear spaces visible as in the case of the European willow gall midge, *Rhabdophaga salicis* Schrk. Palps consisting of two well marked segments, the basal fusiform with several stout, subapical setae, the apical slightly longer, tapering gradually to a subacute point. Mouth parts well retracted, mandibles strongly excavated internally, terminating



Fig. 15 *Lasioptera carbonifera*, three antennal segments of female, much enlarged (Original)

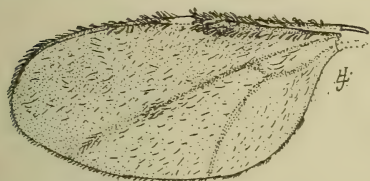


Fig. 16 *Lasioptera carbonifera*, female wing, much enlarged (Original)

in a conspicuous broad, internal tooth. Mesonotum dark brown or black, bordered narrowly anteriorly and laterally with yellowish white, subtriangular scales and with a sparse clothing of yellow hairs posteriorly. Scutellum prominent, arched and rather thickly clothed with short, yellowish scales; postscutellum dark

brown, somewhat lighter anteriorly. Abdomen dark brown with the segments sparsely and somewhat irregularly margined posteriorly with whitish scales, terminal segment brownish. Terminal lobes pedicelled, orbicular. Wings hyaline with the membrane rather thickly clothed with long, coarse hairs; basal portion of the costa and subcosta thickened and thickly clothed with rather large, dark brown striated scales, the subcosta joining the costa at the middle of the wing, which is marked at the point of union by a white spot, the mid vein uniting with the border at the posterior apical fourth, anal vein somewhat angulate near the middle, joining the posterior margin at the basal third. Halteres light brown, basal portion short, stout, apical part slightly fusiform,



Fig. 17 *Lasioptera carbonifera*, last tarsal segment of female, much enlarged (Original)

much elongated, with its tip sparsely clothed with fine, yellowish scales. Anterior leg with coxae light yellowish, dark brown ven-

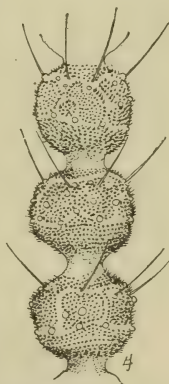


Fig. 18 *Lasioptera carbonifera*, three antennal segments of male, much enlarged (Original)

trally; tibiae and tarsi dark brown, the latter with the segments yellowish white basally; first tarsal segment short, second much

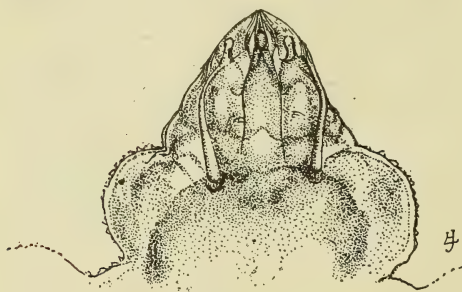


Fig. 19 *Lasioptera carbonifera*, ventral aspect of larval head, possibly near pupation, much enlarged (Original)

produced, third half the length of the second, fourth shorter and about as long as the first, fifth very short; claws bidentate. The middle leg is practically the same as the anterior except for the well defined basal band on the tibia; posterior leg like the middle aside from the first tarsal segment being white and each extremity of the other segments narrowly banded with the

same except the apex of the fifth, which is yellowish.

Male. This sex closely resembles the other except in size. The antennal segments are possibly more cylindric and not quite so much dilated as those of the female, while the palpi appear to differ in having the basal segment considerably larger than the apical, both bearing irregularly located, stout, chitinous setae. Basal clasp segment stout, slightly curved exteriorly, strongly excavated interiorly; terminal clasp segment strongly arcuate, terminating in a rather blunt, dark, recurved spine, other structures indeterminate in the preparation.

Pupa. Yellowish brown with brownish wing pads extending nearly to the middle of the abdomen, the leg cases reaching to the extremity and the antennae extending almost to the basal abdominal segments. This pupa is stout and easily recognized because of the definite markings, there being a series of light lateral spots on each of the brownish abdominal segments. The brown tarsi have definite yellowish white bands.

Larva. The full grown larva is about 1.25 mm long, pale yellowish with the segmentation rather indistinct.



Fig. 21 *Lasioptera carbonifera*, larva, ventral aspect of posterior extremity, enlarged (Original)

Head rather prominent, narrow, tapering anteriorly; antennae apparently three segmented, the basal being stout, a little longer than broad, the second subcylindric, about half the diameter of the first and nearly as long, the third subconical and slightly thicker than the second, giving a capitate



Fig. 20 *Lasioptera carbonifera*, larval breastbone, enlarged (Original)

Head rather prominent, narrow, tapering anteriorly; antennae apparently three segmented, the basal being stout, a little longer than broad, the second subcylindric, about half the diameter of the first and nearly as long, the third subconical and slightly thicker than the second, giving a capitate

appearance to this organ. Chitinous fork or "breastbone" stout, slightly expanded posteriorly, widely produced anteriorly in two conspicuous lateral processes and with a pair of large, well separated anterior teeth. Terminal segment about one half the width of the body, distinctly produced posteriorly and bisected ventrally by the slitlike anal orifice.

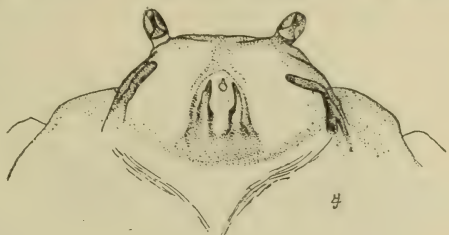


Fig. 22 *Lasioptera vitis*, ventral aspect of larval head, much enlarged (Original)

Grape gall fly (*Lasioptera vitis* (O. S.)). The large, irregular, reddish mass

of tissue produced by this insect has been repeatedly described, while so far as known the larva has not been characterized, though it is an exceedingly peculiar form.



Fig. 23 *Lasioptera vitis*, breastbone, much enlarged (Original)

Larva. The full grown larva is about 3 mm long, yellowish in color and rather slender. Head somewhat retracted, short, tapering rapidly to a nearly truncate anterior margin. Antennae short, stout, basal segment stout, about two thirds as long as broad, apical segment about as long as broad, gently rounded apically and apparently excavated ventrally, there being two broad, ventral, flaplike appendages with gently rounded margins. Chitinous fork or "breastbone" very short, its posterior portion being indistinct, anterior portion broad, stout and with a pair of large, acute, cephalic teeth. Body with many transverse wrinkles, posterior extremity with a simple anal slit and with a pair of rather prominent submedian pseudopods arising from tuberculelike elevations, the

terminal portion of these appendages somewhat fusiform. Anterior of the pseudopods there is a median, large, subtriangular elevation bearing numerous minute tuberculate processes.

Willow potato gall (*Rhabdophaga batatus* Walsh). Very irregular, gouty, polythalamous enlargements occur

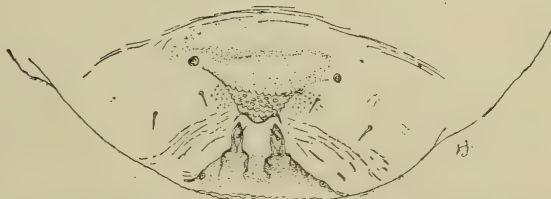


Fig. 24 *Lasioptera vitis*, larva, dorsal aspect of posterior extremity, much enlarged (Original)

on the shoots of low swamp willows. Specimens taken at Karner April 13, 1903, produced adults the 27th. The pupae wriggle partly out of the gall as in the case

of some other species, the flies escaping and leaving the white pupal skins adorning the surface of the gall.

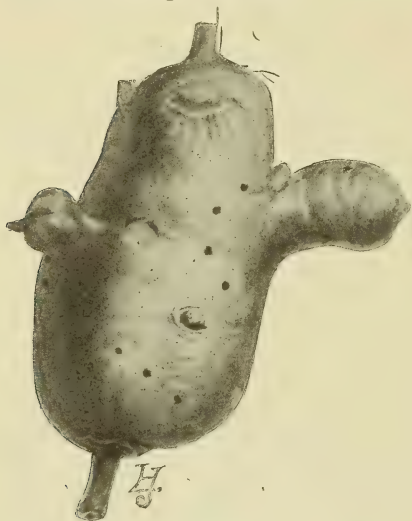


Fig. 25 *Rhabdophaga batatus*, gall enlarged (Original)

Female. Antennae reddish brown; moniliform, reaching to the base of the abdomen and consisting of 20 subsessile segments, the basal one enlarged, subglobular, the second short, the third about twice the length of the preceding and the others decreasing gradually in length to the extremity. There is on each segment a subbasal whorl of rather short, nearly straight setae, while the central portion is more or less irregularly ornamented with long, curved setae arising from conspicuous tubercular elevations. The segments are marked with more or less distinct smooth, transverse lines containing oval, whitish spots at the basal third

and near the apex. In one or two instances there appears to be a slight ridge as described for *R. rigidae*. Eyes black, coarsely granulate, inclosing the base of the antennae; palps composed of five

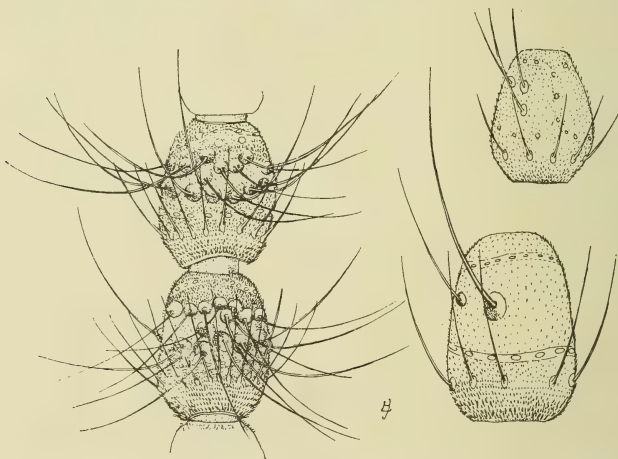


Fig. 26 *Rhabdophaga batatus*, two antennal segments of female, with views of two other segments, much enlarged (Original)

segments, the basal short, rather small, second and third thick, subequal, the fourth the same length as the third, more slender and the fifth about one half longer than the fourth. Mesonotum dark brown with a somewhat distinct median, lighter, broad vitta. Scutellum

prominent, yellowish; postscutellum yellowish, abdomen reddish; terminal lobes slender, finger-shaped. Wings subhyaline, anterior veins dark brown; subcosta joining costa before the middle and the second longitudinal vein uniting with the border before the

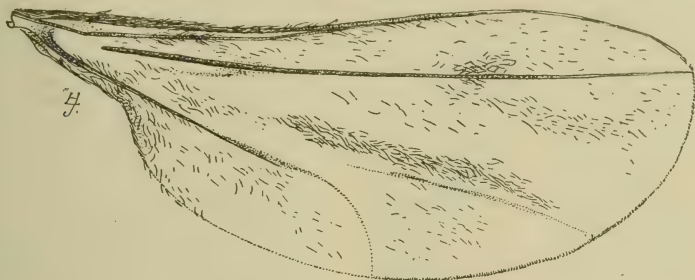


Fig. 27 *Rhabdophaga batatus* female wing, much enlarged (Original)

apex; anal vein uniting with the posterior margin at the apical third, its branch at the basal third. Halteres with a slender, semitransparent, long pedicel, apex expanded, fusiform, yellowish. Legs pale yellowish, first tarsal segment of posterior leg short, second very much prolonged, third one half as long as the second, fourth two thirds as long as the third and the fifth about half as long as the

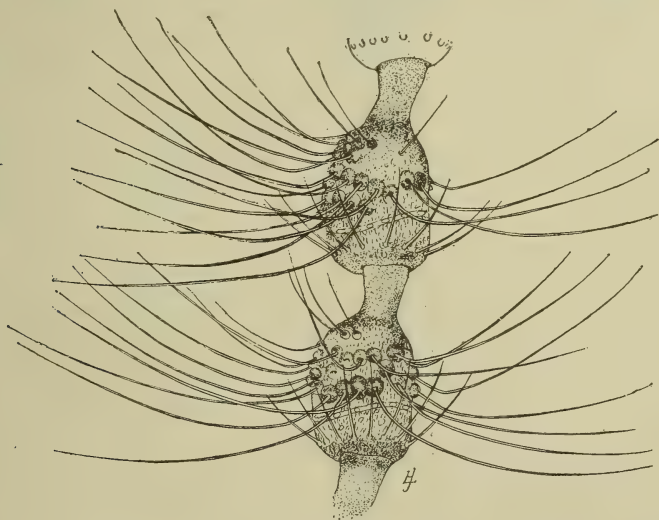


Fig. 28 *Rhabdophaga batatus*, two antennal segments of male, much enlarged (Original)

fourth; claws simple, empodium well developed. Length nearly $\frac{3}{16}$ inch, wing spread $\frac{1}{4}$ inch.

Male. The dark red antennae extend to the middle of the body and are composed of 19 segments, the first and second each stout,

subglobular and the 3d to 18th inclusive, pedicellate, 19th simple. Each segment consists of a broadly expanded basal two thirds, the remainder forming a simple, narrow pedicel. The enlarged part bears a basal whorl of short, nearly straight setae followed by irregularly placed, long, curved setae arising from conspicuous tubercular elevations. Most of the segments appear to have a distinct though nearly invisible ridge with whitish, oval spots along its length at the basal third of the enlargement. Male genitalia with the clasp segment rather slender, strongly curved exteriorly, nearly straight interiorly, the apical segment strongly curved and

tapering gradually to an acute, dark apical tooth. Dorsal lamella greatly dilated, broadly rounded laterally, nearly divided and widely separated posteriorly; ventral lamellae slender, nearly parallel, tapering gradually to a rather acutely rounded apex. Stylet rather prominent, stout, tip broadly rounded.

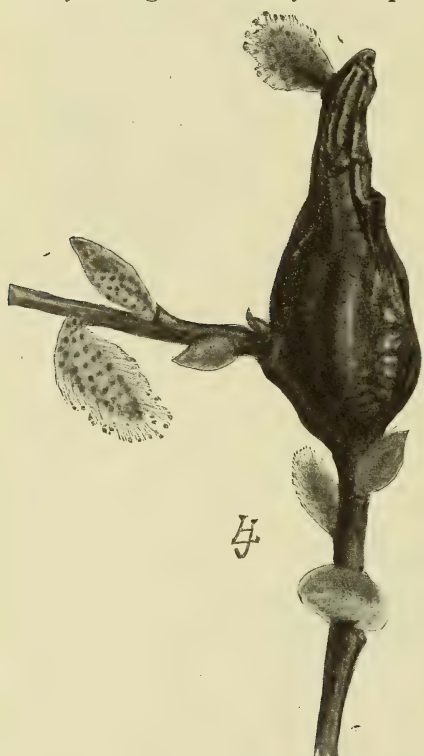
Described from alcoholic specimens.

Willow beak gall (*Rhabdophaga rigidae* n. sp.). The galls of this species are comparatively common on the small willows (*Salix rigidae* and *S. lucida*) in the vicinity of Albany and may be instantly recognized by their terminal or subterminal location and fusiform shape. They are about an inch long and are tipped with a rather characteristic, slender, curved beak. The gall of this

Fig. 29 *Rhabdophaga rigidae*, gall enlarged (Original)

species was early described by Dr Fitch under the name of *Cecidomyia salicis*, and on account of its specific name being preoccupied, it was changed by Baron Osten Sacken to *C. rigidae*.

Female. Antennae dark brown, moniliform, composed of 24 or 25 segments and extending to the base of the wings; basal segment much enlarged, subglobular, the second short, thick, the third somewhat elongate and with a very short pedicel, the fifth and following



subglobular, decreasing gradually in length and each except the last with a rather well marked, short pedicel. The enlarged portion of the segment bears near its base a nearly uniform row or whorl of rather stout, slightly curved setae, and the remainder of the distal surface is sparsely ornamented with longer, more curved setae arising from distinct setigerous punctures, each segment with a distinct though not conspicuous transverse ridge with white punctures at regular intervals on the basal third and another at the distal border of the enlargement. Palpi composed of five segments, basal short, second longer, third a little shorter than the second and about equal to the fourth, fifth slender, finger-shaped and about as long as the two preceding segments. Eyes black, coarsely granulate and inclosing the base of the antennae. Mesonotum dark brown or black, with a more or less distinct pair of curved, lighter, submedian vittae expanding anteriorly and a lighter area at the base of the

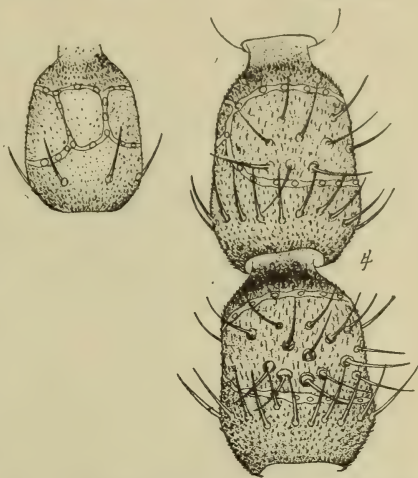


Fig. 30 *Rhabdophaga rigidae*, two antennal segments of female, with another aspect of a third, much enlarged (Original)

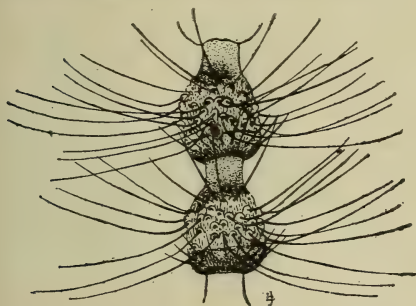


Fig. 31 *Rhabdophaga rigidae*, two antennal segments of male, much enlarged (Original)

wing. Scutellum prominent, with a median, lighter spot; postscutellum yellowish. Abdomen reddish brown, terminal lobes slender, broadly rounded apically and thickly clothed with long, slender setae. Wings with a distinct fucous shade; anterior veins brown, well marked; subcosta joining costa at the middle, the first longitudinal vein uniting with the border just before the apex, anal vein indistinct distally, its posterior fork uniting with the margin at the posterior third. Halteres with a slender, yellowish pedicel, distal portion strongly capitate, semitransparent, whitish. Legs yellowish, first tarsal segment of posterior leg very short, second much produced, third about half the length of the second, fourth a little shorter than the third and the fifth half the length of the fourth; claws simple, empodium well developed. Length $\frac{1}{4}$ inch, wing spread $\frac{3}{8}$ inch.

Male. Antennae brown, extending to the base of the abdomen and composed of 24 pedicellate segments, the first subglobular, much enlarged, the second stout, the others with the exception of the last, each with a smooth pedicel about one third the length of the segment. The enlarged portion is ornamented basally with

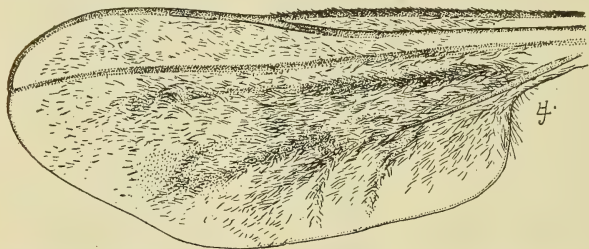


Fig. 32 *Rhabdophaga rigidae*, male wing, much enlarged (Original)

a regular row of short, straight setae, the remainder being thickly clothed with long, slender, curved setae arising from prominent setigerous tubercles. There is a distinct though not conspicuous transverse band with a line of white spots along its length near the basal fourth, much as in the female. There appears to be another similar structure at the apical portion of the enlargement as in the opposite sex. Male genitalia with the basal clasp segment broadly dilated at the base, slightly rounded exteriorly, strongly so interiorly and obliquely truncate apically; terminal clasp segment broadly expanded at the base, curved and tapering to a strong, dark, chitinous point. Dorsal lamella deeply incised mesially, each lobe stout and broadly rounded at the apex; ventral lamella broad, truncate apically, gently rounded and produced laterally; stylet stout, short, broadly rounded apically.

The above are described from alcoholic specimens bred from twigs taken at Karner April 13, 1903, adults appearing the 27th.

Pupa. Stout, brown, curved, $\frac{1}{4}$ inch long, wing cases reaching to base of the third abdominal segment, leg sheaths extending to the sixth abdominal segment. Antennae with a small, basal, tubercular process and extending to the base of the abdomen.

Larva. Yellowish, stout, $\frac{3}{16}$ inch long and with the segments well marked. Head small, retracted; antennae with a large basal and a smaller terminal conical segment. Chitinous fork or "breastbone" short, stout, with the arms well separated and bearing conical, polished, acute teeth, basal parts dark though not sharply defined. Spiracles occur on the 2d and 5th to 12th segments inclusive, those on the latter

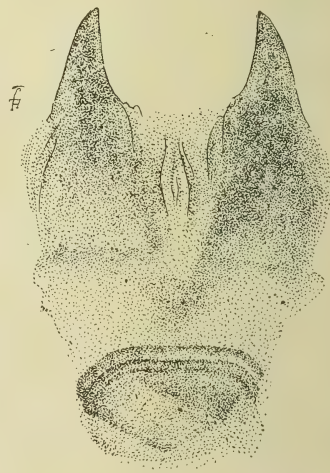


Fig. 33 *Rhabdophaga rigidae*, larval breastbone, enlarged (Original)

being sublateral, each consisting of a circular, chitinous elevation with a median depression or aperture.

Black locust midge (*Dasyneura pseudacaciae* Fitch). Occasionally young leaves of black locust are badly deformed by being folded together so as to produce peculiar podlike galls about $\frac{1}{4}$ inch long. This is the work of the above named small, black midge or fly, which probably deposits two or three eggs in each unfolding leaf. The young maggots hatching therefrom produce sufficient irritation to prevent the leaf unfolding, and its free edges adhering together more or less form a fairly perfect gall, within which the nearly helpless larva develops to maturity. Sometimes this species is very numerous, since we received specimens from Mr C. L. Williams of Glens Falls, N. Y., accompanied by the statement that some parts of a black locust hedge had nearly every leaf infested by this little insect. It is rarely so abundant as this, though Dr Smith records it as a common species in New Jersey.

This insect is with very little doubt the same as that described under the above specific name and referred to the genus *Cecidomyia* by Dr Fitch in his 5th report for the year 1859, page 53. Some years later Baron Osten Sacken described what is very probably the same form, under the name of *Cecidomyia gleditchiae*. There are some inconsistencies in colorational characters between the two descriptions, but these perhaps may be partly explained by one describing more matured or even dried specimens while the other characterized fresh individuals.

Description. This little fly was described by Dr Fitch as follows: "A small, blackish midge, the base of its thorax tawny yellow, its abdomen pale yellowish, with the tip dusky and clothed with fine hairs, as is also the neck; its legs black, with the thighs pale except at their tips; its wings dusky, feebly hyaline, with the fringe short; its antennae with 13 short cylindrical joints separated by short pedicels; its length, .065 inch to the tip of the body."

The above description varies somewhat from dried specimens bred by us in July, and the discrepancy is probably due to the drying of the specimens.

Female. Antenna dark brown, moniliform, extending to the base of the wing and composed of 14 stout, closely set segments, each rather sparsely clothed with long, somewhat stout, curved setae arising from conspicuous elevations. Careful focusing brings out more or less distinctly on each segment a middle and subapical,

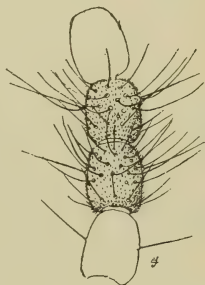


Fig. 34 *Dasyneura pseudacaciae*, antennal segments of female, much enlarged (Original)

transverse row of pale, circular spots, which are evidently connected on one side at least by a similar longitudinal row as in the

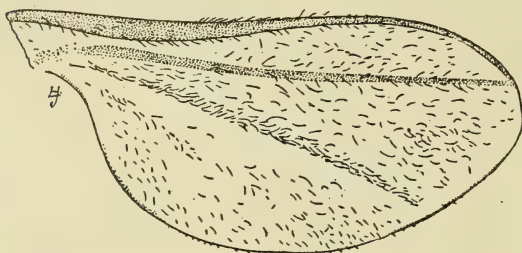


Fig. 35 *Dasyneura pseudacaciae*, female wing, much enlarged (Original)

case of *Rhabdophaga salicis* Schrk. Palps composed of five distinct segments, a short, basal one, the second a little longer, the third and fourth fully half longer than the second and the fifth about half longer than either the third or fourth,

all sparsely ornamented with irregularly placed, stout setae; mouth parts rather prominent. Eyes large, coarsely granulate. Mesonotum light brown with indistinct grayish vittae and with a sparse clothing of fine, yellowish hairs. Scutellum prominent, crowned with a sparse row of golden yellow setae, dark brown anteriorly, golden yellow posteriorly; postscutellum golden yellow. Abdomen dark brown or reddish, sparsely ornamented with rather coarse golden yellow setae, pleura yellowish. Wings hyaline sparsely clothed with rather coarse, curved hairs; base of costa a little more thickly clothed and with a few linear scales; subcosta rather indistinct, uniting with costa at the basal third; first longitudinal vein well marked, joining the border just before the apex, anal vein indistinct. Halteres with a long, yellowish pedicel, apex greatly enlarged, elongate, fuscous. Legs pale yellowish clothed with a silvery white pubescence, first tarsal segment very short, second much prolonged, third less than one half that of the second, fourth and fifth each two thirds the length of the preceding segment. Claws simple, empodium well developed. Terminal abdominal lobes slender, finger-shaped.

Male. Antennae composed of 14 segments, all except the basal two and the 14th pedicellate distally; the apical two thirds of the large basal portion of each irregularly ornamented with conspicuous

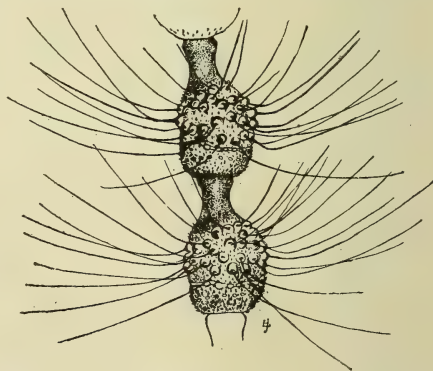


Fig. 36 *Dasyneura pseudacaciae*, two antennal segments of male, much enlarged (Original)

setigerous tubercles bearing long, slightly curved setae two or three times as long as the width of the segment, the distal third of the latter smooth, narrow, forming a pedicel. There is a narrow, distinct though inconspicuous, transverse, white spotted band at the

basal third of each segmental enlargement. Male genitalia with the basal clasp segment stout, much expanded basally, terminal clasp segment rather stout, short, tapering gradually to a rounded, denticulate tip; dorsal lamella long, very deeply incised, tips of lobes subacute; ventral lamellae broad, distant, the inner margins approaching each other posteriorly, the tip subacute with the outer margin broadly rounded and produced laterally; stylet short, broad, with a rounded apex.

Pupa. Brownish, length $\frac{1}{16}$ inch. The antennae reach to the base of the wings, the wing pads extend to the tip of the second abdominal segment and the leg sheaths to the third and fourth abdominal segments; eyes dark brown. The long, slender spines originate near the base of the antennae.

Larva. Pale yellowish, $\frac{3}{8}$ inch long. Segmentation rather well marked. Head retracted, small, antennae simple with a rather large, conical, terminal segment. Chitinous fork or "breastbone" Y-



Fig. 37 *Dasyneura pseudacaciae*, larval breastbone, much enlarged (Original)

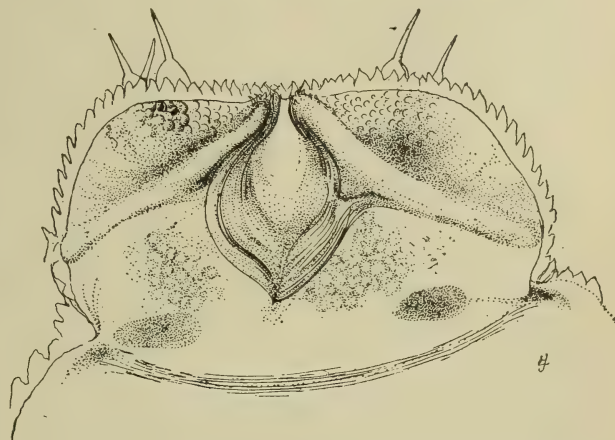


Fig. 38 *Dasyneura pseudacaciae*, larva, ventral aspect of posterior extremity, much enlarged (Original)

shaped, basal portion long, expanded posteriorly; branches of the fork stout, well separated, obliquely, arcuately truncate; posterior extremity relatively simple with lateral groups of stout, semitransparent spines posteriorly.

Trumpet vine midge (*Bremia tecomae* n. sp.). Our attention was called to the work of this insect in early September by the crumpling of the leaves of a trumpet vine. The minute, pale yellowish larvae were found within the distorted leaves, and adults were bred a few days later. This insect was so abundant as to seriously injure a small trumpet vine in Albany. The larvae did not produce galls, but their operations on the under surface of the leaf resulted in pseudogall-like formations partially sheltering the

tender maggots which were otherwise without protection and fed on the nearly exposed leaf surface.

This species, apparently unknown, may be recognized by the following characteristics:

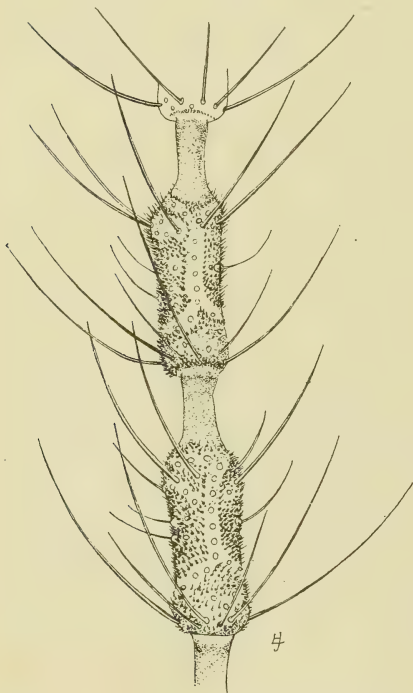


Fig. 39 *Bremia tecomiae*, two antennal segments of female, much enlarged (Original)

Female. Antennae fuscous yellow, about two thirds the length of the body and composed of 14 segments, the first short, subglobular, the second stout, elongate and the 3d to the 14th inclusive, pedicellate distally. A typical segment has the basal two thirds cylindric, broadly dilated and bearing a basal and subapical whorl of long, stout setae, an intervening space thickly ornamented with irregularly placed black, chitinous spots, and on focusing, showing pale, transverse and longitudinal lines inclosing circular areas much as in *Rhabdophaga salicis* Schrk. The distal third of the segment is slender, smooth, with the apex slightly expanded. Palpi long, composed of five segments, the basal two short, stout, subequal, the third a little longer, the fourth and fifth one half longer, subequal, slender; all sparsely ornamented

with stout setae. Mandibles distinct, broad and with a number of subapical, apical and lateral, stout setae. Eyes large, jet-black, rather coarsely granulate and confluent. Thorax yellow with lateral, yellowish, fuscous, mesonotal elevations at the base of the wings, and with fuscous, chitinous, rounded elevations above the base of the somewhat fuscous anterior coxae.

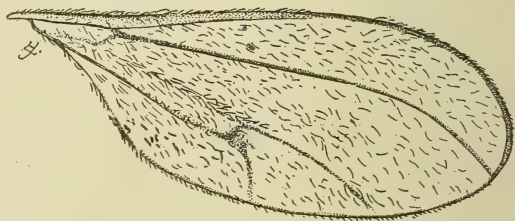


Fig. 40 *Bremia tecomiae*, female wing, much enlarged (Original)

Abdomen lemon-yellow, slightly fuscous apically, terminal lobe slender, tapering to a minute rounded apex. Wings semitransparent with iridescent reflections, membrane rather thickly clothed with

long, fine hairs; subcosta indistinct, uniting with the margin at the basal third; first longitudinal vein distinct and extending to the posterior margin just behind the apex, anal vein indistinct, joining the posterior margin at the distal third and its branch near the basal third. Legs pale yellowish, rather thickly clothed with grayish brown hairs, tarsi lighter; first tarsal segment short, second very much produced, third about one half the length of the second, the fourth two thirds the length of the third, and the fifth a little shorter. Claws simple, empodium well developed.

Male. Very similar to the female, except that the antennae are about as long as the body, and the distal segments presumably 3 to 14 inclusive, have two subglobular dilations, one at the base and the other at the apical third. The basal subglobular dilation bears a whorl of very long, stout, simple setae and just distally thereof, a whorl of fine, much shorter, arched filaments.

The distal pear-shaped enlargement bears a whorl of stout setae a little beyond its middle, and at its base and near the apex, whorls of fine, arched filaments like that on the basal enlargement; both dilations are ornamented with many irregularly placed, chitinous spots, the basal being separated by a narrow, smooth stem from the distal, and that in turn from the basal of the next segment by a similar stem or pedicel. The coarse, granulate eyes are larger than in the female and inclose a greater proportion of the head. The abdomen is more slender and the terminal appendages are dark brown. Male genitalia with the basal clasp segment stout, broadly curved exteriorly and somewhat arcuate interiorly, distal internal margin oblique. Terminal clasp segment stout, tapering gradually to a strong, bidentate apex. Dorsal lamella irregularly rounded distally, deeply incised mesially, ventral lamella with distinct lateral orbicular lobes separated by a deep medium incision; stylet slender, broadly rounded at the apex.

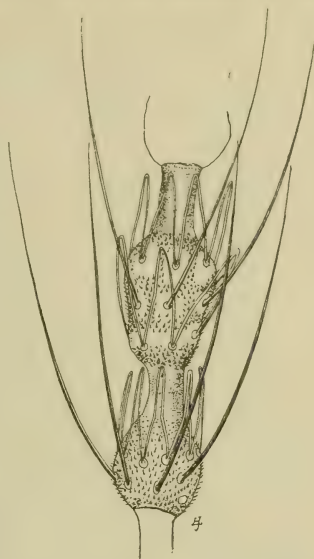


Fig. 41 *Bremia tecomiae*, one antennal segment of male, much enlarged (Original)



Fig. 42 *Bremia tecomiae*, pupal skin, much enlarged (Original)

Pupa. Pupa yellowish with wing pads extending two thirds the length of the abdomen, the leg cases reaching to the extremity and the antennae touching the basal abdominal segments, which latter are ornamented dorsally with irregular, double rows of chitinous spines. The conspicuous dorsal processes are slender, curved,

tapered to an acute point and are three fourths as long as the width of the pupa.

Larva. The full grown larva is about 1.5 mm long, pale yellowish, with the segmentation distinctly marked. Head rather prominent, narrow, tapering anteriorly, antennae consisting of a very broad, retracted basal segment and a rather large, spindle-shaped, terminal segment. Chitinous fork or "breastbone" Y-shaped, the anterior arms broad, well separated, each slightly emarginate anteriorly, distal extremity somewhat enlarged. Antepenultimate abdominal segment with a pair of sublateral, chitinous, dark brown tubercles ventrally, while on the dorsum there appears to be a median, subconical, slightly curved, chitinous tubercle, the last segment with two pairs of sublateral minor protuberances.

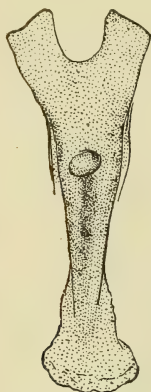


Fig. 43. *Bremia tecomiae*, larval breastbone, much enlarged (Original)

Chokecherry gall fly (*Cecidomyia virginianiae* n. sp.). The peculiar enlarged, galled fruit of the chokecherry, *Prunus virginianus*, has been known for some time and was noticed by the late Dr Lintner in his 12th report for 1896, p. 313.

He there states that cherries apparently galled by this insect have been very abundant in Keene Valley, and adds that Prof. George F. Atkinson of Cornell University named and described a fungus, *Exoascus cecidomophilus*, which was usually associated with these insects. Repeated though unsuccessful efforts have been made to obtain the adult, and, lacking this, we have deemed it advisable to describe and illustrate the larva under the above name.

Larva. The full grown larva is 2.5 mm long, yellowish or yellowish red in color and rather stout. Head rather prominent, narrow, tapering very slightly anteriorly and with short, rather conspicuous two segmented antennae. The first joint of the latter is very short, about twice as broad as long, the second subconical and twice as long as broad. Chitinous fork or "breastbone" rather long, slender, basal portion simple, of uniform size; anterior part greatly dilated and with two short, distinct cephalic teeth or dentitions. Body segments each with a pair of submedian ventral and lateral setae; dorsum apparently simple. Spiracles on the second thoracic and the abdominal segments evident, those on the eighth being sub-

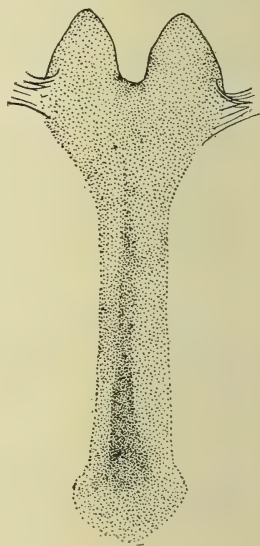


Fig. 44. *Cecidomyia virginianiae*, larval breastbone, much enlarged (Original)



Fig. 45 *Cecidomyia virginianiae*, larva, dorsal aspect of posterior extremity, much enlarged (Original)

median, others nearly lateral. Posterior extremity with a simple anal slit, and with a pair of conspicuous submedian, subconical pseudopods, a median pair of smaller tubercles lying between the latter and similar sublateral ones anteriorly.

Gouty elder gall (*Cecidomyia sambucini*, sp.). This is an irregular gnarly swelling on one side of small elder stems, about $1\frac{3}{4}$ inch long and $\frac{3}{4}$ inch in diameter. Adults were not obtained

Larva. The full grown larva is about 3 mm long, yellowish red and rather stout. Head moderately prominent, enlarged at the base, rounded laterally and tapering rapidly to a broadly rounded apex. Mouth parts very small and indistinct. Chitinous fork or "breastbone" long, slender, basal portion indistinct, anterior part broadly rounded with two large, lateral, blunt teeth and a smaller median one. Body smooth, spiracles moderately prominent. Anal slit simple, extending across most of the posterior extremity, which latter bears a few slender, transparent, spiny processes.



Fig. 46 *Cecidomyia sambucini*, gall, natural size (Original)



Fig. 47 *Cecidomyia sambucini*, larval breastbone, enlarged (Original)

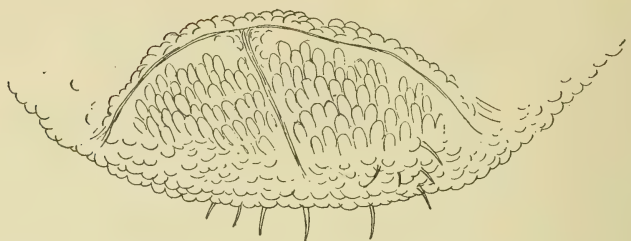


Fig. 48 *Cecidomyia sambuci*, larva, ventral aspect of posterior extremity, enlarged (Original)

VOLUNTARY ENTOMOLOGIC SERVICE OF NEW YORK STATE

This work has now been carried through seven seasons and has resulted in the accumulation of a large amount of data particularly valuable because it relates to the relative abundance of a number of common pests, species so well known as to be rarely the subject of careful records. Such data continued through a series of years as previously pointed out should prove of considerable service in determining the causes governing insect outbreaks. Particularly is this true if these reports are correlated with temperature fluctuations and other climatic changes, which evidently have a profound influence on insect life, specially during the hibernating winter period. It is still early to draw conclusions upon this important point, as observations should be continued over a series of years. It will be noticed that some observers attribute the relative scarcity of insect depredations to the midsummer drouth. This is undoubtedly the case with some species, while injuries by other forms were emphasized because the dry weather prevented the normal growth of vegetation and thus made apparent depredations which under ordinary conditions escape notice. This was particularly true of the webworm outbreak in Rensselaer, Columbia and Albany counties, noticed on page 67.

The corps of voluntary observers aside from rendering more or less regular reports on local conditions has proved of great service in the case of unusual outbreaks of one kind or another. All parties have responded cheerfully to requests from the office, making it possible in emergencies when serious injuries like those of the webworm in the eastern part of the State or that of the army worm in the western part of the State are threatened, to determine within a few days the approximate extent of the depredations.

This is something of very great importance at times and would have proved of much service in 1896, when the army worm inflicted serious losses in 55 of the 60 counties then existing.

Cattaraugus county [C. E. Eldredge, Leon] — Potato beetles (*Doryphora decim-lineata* Say) are unusually abundant. Horn flies (*Haematobia serrata* Rob.-Desv.) are very numerous and annoying to cattle. Fall webworms (*Hyphantria textor* Harr.) have appeared in large numbers on appletrees. Mosquitos have been exceedingly abundant the past two or three weeks.—*July 25*. There is no evidence of army worms (*Heliophila unipuncta* Haw.) in this section.—*August 2*

[F. A. Fitch, Randolph] — Grasshoppers are not abundant and squash bugs (*Anasa tristis* DeGeer) are scarce. Striped cucumber beetles (*Diabrotica vittata* Fabr.) were very thick the middle of June but have largely disappeared. Potato beetles have been very numerous and the same is true of the Texas horn fly, which has been quite annoying to stock.—*July 5*. Potato beetles continue to be abundant and green horseflies (probably *Tabanus lineola* Fabr.) have been quite numerous. Mosquitos are not so abundant as three weeks ago. Insects appear to have been kept under control largely by the cool wet weather.—*July 12*

Dutchess county [Henry D. Lewis, Annandale] — The scurfy scale (*Chionaspis furfura* Fitch) is unusually prevalent and destructive on young fruit trees in this section.—*May 25*. Plant lice are becoming somewhat abundant. Apple aphids (*Aphis mali* Linn.) have appeared in considerable numbers and threaten to cause serious injury. Striped cucumber beetles (*Diabrotica vittata* Fabr.) and squash bugs (*Anasa tristis* DeGeer) are both very abundant.—*June 7*. Spittle insects (probably *Philaenus lineatus* Linn. or *P. spumarius* Linn.) are quite numerous on grass, attracting attention because of the conspicuous frothy masses here and there on almost every grass stem in restricted areas. Plant lice are about the only insects present in numbers.—*June 13*. Apple aphids continue very abundant and are causing a great deal of damage, especially on young trees. Potato beetles (*Doryphora decim-lineata* Say) are more numerous than for several years. There is some pear psylla (*Psylla pyricola* Forst.) in evidence.—*July 8*. Pear psylla has increased somewhat and, the aphids on apple have nearly

disappeared. Potato beetles are more numerous than they have been for years. The scurfy scale is generally abundant and threatens to cause considerable injury.—*July 29*

Erie county [John U. Metz, Swormville] — Mosquitos are present in great numbers and currant worms (*Pteronus ribesii* Scop.) are abundant. Potato beetles (*Doryphora decim-lineata* Say) are very evident. Horn flies (*Haematobia serrata* Rob.-Desv.) have been rather annoying to stock some two weeks. Green-headed horseflies (probably *Tabanus lineola* Fabr.) are much more common than usual, small swarms following teams about. There is no evidence of injury to wheat by Hessian fly (*Mayetiola destructor* Say).—*July 18*

Genesee county [J. F. Rose, South Byron] — Tent caterpillars (*Malacosoma americana* Fabr.) are very scarce, only three nests having been observed. Plant lice are abundant on roses.—*May 24*. There are no complaints of injury by striped cucumber beetles (*Diabrotica vittata* Fabr.) and potato beetles (*Doryphora decim-lineata* Say) are not injurious. Rose slugs (*Monostegia rosae* Harr.) are much more numerous than usual.—*July 3*. Fall webworm (*Hyphantria textor* Harr.) appears to be becoming more injurious each year. Squash bugs (*Anasa tristis* DeGeer) and striped cucumber beetles are not abundant. Tussock moth caterpillars (*Hemerocampa leucostigma* Abb. & Sm.) are more numerous than usual but not causing serious damage in this vicinity. Potato beetles are quite plentiful though they are easily controlled by thorough and timely spraying.—*July 20*

Greene county [O. Q. Flint, Athens] — Tent caterpillars (*Malacosoma americana* Fabr.) are remarkable for their scarcity, not one nest having been observed.—*June 13*. Spittle insects (probably *Philaenus lineatus* Linn. or *P. spumarius* Linn.) are somewhat abundant and have attracted notice because of the tops of injured grass stems dying.—*July 4*. Plant lice have been more than ordinarily destructive in gardens, even cabbage plants being affected. Potato beetles (*Doryphora decim-lineata* Say) are about as destructive as usual. The elm leaf beetle (*Galerucella luteola* Müll.) is quite scarce and there is very little evidence of tent caterpillar work. Pear orchards have suffered considerable injury, many of the trees turning black and dying. This is probably due

to the exceptionally severe weather of winter before last, in some instances supplemented by bacterial or fungous disease or insect injury. The trees had vitality enough to live through one summer but were unable to survive another winter.—*July 18*. Fall webworms (*Hyphantria textor* Harr.) are quite numerous. Plant lice have been somewhat annoying to lettuce and other tender plants. The elm leaf beetle while evident has not been so destructive as in some other years.—*July 27*

Herkimer county [George S. Graves, Newport] — The oyster scale (*Lepidosaphes ulmi* Linn.) appears to have been very prolific, judging from its abundance on trees this spring.—*April 20*. It appears to be a very serious pest in the apple orchards of this section. The cold wet weather is retarding insect development.—*May 15*. Currant worms (*Pteronus ribesii* Scop.) were seen May 16 and two nests of tent caterpillars (*Malacosoma americana* Fabr.) observed the 18th. The season appears to be a very irregular one and comparatively few insects are abroad. White grubs (*Lachnosterna* species) seem to be the principal grass enemy in this section.—*May 23*. Black flea beetles (*Epitrix cucumeris* Harr.) were observed on cucumber plants May 27. Tent caterpillars are remarkably scarce.—*June 2*. Young currant worms were hatching June 4, and the first potato beetles (*Doryphora decim-lineata* Say) were seen the 8th, the adults being scarce. Currant aphid (*Myzus cerasi* Fabr.) have been increasing rapidly within a few days. Flies are also becoming aggressive.—*June 19*. Potato beetle larvae were observed June 25, though the adults are somewhat scarce. Elm aphids (probably *Callipterus ulmifolii* Mon.) are present in some numbers. Currant aphid is causing some injury, particularly since there has been a week of hot weather. Apple aphids (*Aphis mali* Linn.) are present in small numbers.—*July 1*. Another brood of currant worms appeared July 4. Striped cucumber beetles (*Diabrotica vittata* Fabr.) are causing considerable injury. Flea beetles are not much in evidence.—*July 10*. Rose beetles (*Macrodactylus subspinosus* Fabr.) are abundant and feeding on plants of many kinds. Cabbage butterflies (*Pieris rapae* Linn.) appear to be somewhat numerous. Currant worms have been destructive for a week past. Black-headed turnip worm (*Evergestis straminealis* Hüb.) is seriously injuring turnip leaves. Horn flies (*Haematobia serrata* Rob.-Desv.) are more or less trouble-

some to cattle. The foliage of red cedartrees is badly eaten, possibly by the rose beetle. Large numbers of plant lice (probably the undescribed *Lachnus smilacis* Willm.) were found on smilax.—*July 20*. The peculiar subglobular galls of *Cecidomyia verrucicola* O. S. are quite abundant on basswood leaves.—*July 22*. Horn flies appear to be increasing in numbers and potato beetles are not very destructive, while currant worms have been more injurious than usual. Grasshoppers are quite scarce.—*July 28*. Black plant lice (probably *Aphis rumicis* Linn.) occur in great abundance on pigweed (*Chenopodium*). Fall webworms (*Hyphantria textor* Harr.) are very scarce, but one nest being observed. Horn flies are exceedingly abundant and annoying to cattle. The season appears to be from 10 days to 2 weeks later than usual.—*August 8*. Young currant worms are present in considerable numbers.—*August 12*. Cabbage butterflies are becoming numerous and horn flies are exceedingly abundant and troublesome. Excessive rains and high winds have destroyed many insects.—*August 17*. Fall webworm nests are becoming more numerous. Codling moth larvae (*Carpocapsa pomonella* Linn.) appear to be more destructive than usual. This may possibly be due to the small amount of fruit emphasizing its injury. The black walnut trees in this section are more or less severely injured from year to year by some insect which strips the leaves therefrom (possibly the work of the black walnut worm, *Datana integerrima* Grote & Rob.). Spiny elm caterpillars (*Euvanessa antiopa* Linn.) are working in small numbers on both elm and willow.—*August 29*. Grasshoppers are somewhat abundant in dry pastures and gardens and fall webworms are quite numerous on all trees except maple.—*September 27*

Onondaga county [Mrs A. M. A. Jackson, Warner]—Plant lice have not been at all abundant in this section. Black flea beetles (*Epitrix cucumeris* Harr.) are present in small numbers. Not a striped cucumber beetle (*Diabrotica vittata* Fabr.) has been observed. Rose beetles (*Macrodactylus subspinosus* Fabr.) are present in small numbers and are not doing much damage. Rose leaf hoppers (*Typhlocyba rosae* Harr.) are not very abundant. Tussock caterpillars (*Hemerocampa leucostigma* Abb. & Sm.) are much later than usual and are present only in small numbers. Plantains have been seriously injured in some places by a leaf miner (prob-

ably the plantain leaf miner, *Dibolia borealis* Chev.).—*July 12.* Dog day Cicadas (*Tibicen tibicen* Linn.) were observed in small numbers July 16. Cabbage butterflies (*Pieris rapae* Linn.) are common along the highways. Currant worms (*Pteronous ribesii* Scop.) have been abundant in some gardens while in others there is very little injury. The horn fly (*Haematobia serrata* Rob.-Desv.) and the stable fly (*Stomoxys calcitrans* Linn.) have been very annoying to cattle. Warm damp weather has been followed by the appearance of many mosquitos. There is a report to the effect that wheat in this vicinity has been injured by some root worm.—*July 19.* Codling moth (*Carpocapsa pomonella* Linn.) injury has been quite prevalent in early apples. Later varieties do not show as much damage. Fall webworm (*Hyphantria textor* Harr.) nests are to be seen in small numbers. Egg belts of tent caterpillars (*Malacosoma americana* Fabr.) are scarce.—*August 3*

Orleans county [Virgil Bogue, Albion] — Rose beetles (*Macrodactylus subspinosus* Fabr.) have been somewhat more abundant than usual, though the damage inflicted was not very great, due to the fact that the unusual growth of foliage more than counterbalanced their work. There are three breeding areas of this insect in the county, one is located 1 mile east of here, one in the southwest corner of the county and one 5 miles north of Medina. Potato beetles (*Doryphora decim-lineata* Say) are as abundant as usual. The trees have grown so vigorously that aphids have had little opportunity to inflict injury. Pear slugs (*Eriocampoides limacina* Retz.) have been unusually scarce owing to excessive rains. Late cherries have been exceptionally free from worms (probably the cherry maggot, *Rhagoletis cingulata* Loew).—*July 17*

Queens county [C. L. Allen, Floral Park] — Cutworms have been very destructive and are still doing a great deal of injury, cutting off all the early cabbages in many places and causing much mischief with tomatoes. Woolly maple leaf aphids (*Pemphigus acerifolii* Riley) have appeared in some numbers though they are not doing much injury.—*July 3*

Richmond county [David Muirhead, West New Brighton] — Potato beetles (*Doryphora decim-lineata* Say) are fairly abundant and correspondingly injurious. Cabbage butterflies (*Pieris rapae* Linn.) and cabbage worms are somewhat numerous, the latter inflicting more or less damage.—*July 16*

St Lawrence county [C. J. Locke, Ogdensburg] — Currant worms (*Pteronous ribesii* Scop.) appeared May 15 and larvae were at work July 1. Asparagus beetles (*Crioceris asparagi* Linn.) and the cottony maple scale (*Pulvinaria innumerabilis* Rathv.) were observed July 10. Black flea beetles (*Epitrix cucumeris* Harr.) are numerous and striped cucumber beetles (*Diabrotica vittata* Fabr.) were present in some numbers July 1. Fall webworms (*Hyphantria textor* Harr.) are rather numerous. Tussock moth larvae (*Hemerocampa leucostigma* Abb. & Sm.) are numerous and destructive on maples and elms.—*July 28*

Suffolk county [Frank E. Lutz, Cold Spring Harbor] — San José scale (*Aspidiotus perniciosus* Comst.) is greatly feared in this section and is apparently becoming generally distributed. The green striped grasshopper (*Chortophaga viridifasciata* DeGeer) was taken March 20.—*April 8*. *Hyphantria textor* Harr., *Apantesis virgo* Linn., *Isia isabella* Abb. & Sm. and *Estigmene acraea* Drury are still common at the trap lantern.—*June 10*. Asparagus beetles (*Crioceris asparagi* Linn. and *C. duodecim-punctata* Linn.) were observed, the former abundant, the latter rare. Potato beetles (*Doryphora decim-lineata* Say) occur in small numbers; the small black flea beetle (*Epitrix cucumeris* Harr.) is abundant and destructive on tomatoes. A dipterous larva (probably the radish miner *Anthomyia radicum* Linn.) is at work in radish roots.—*May 24*. The striped cucumber beetle (*Diabrotica vittata* Fabr.) is fairly abundant and the fall webworm moth (*Hyphantria textor* Harr.) is somewhat numerous at lights. The small black flea beetle was so abundant as to nearly destroy some petunias. The radish worms have been somewhat injurious in several localities, in at least one case almost destroying the crop. Rose beetles (*Macrodactylus subspinosus* Fabr.) are exceedingly abundant and destructive. The white marked tussock moth (*Hemerocampa leucostigma* Abb. & Sm.) is reported as causing a great deal of injury in Brooklyn.—*July 6*. Salt marsh mosquitos (*Culicada sollicitans* Walk.) were exceedingly abundant last week, though local marshes were well oiled. This is our usual end of the season's invasion from the south side.—*August 25*

Sullivan county [J. E. Barkley, Grahamsville] — Potato beetles (*Doryphora decim-lineata* Say) were observed May

27, and cucumber beetles (*Diabrotica vittata* Fabr.) were abroad May 23 in sufficient numbers, so that serious injury will result if they are not kept in check by poisoned sprays. Currant worms (*Pteronusribesii* Scop.) are becoming very destructive to both currants and gooseberries. Hellebore and insect powder seem to be of little value compared with the arsenical spray. Ants of various kinds are proving very troublesome and promise to become as serious an annoyance as last year when they overran everything and it was almost impossible to protect victuals and other articles from their ravages.—*May 29.* The small black flea beetle (*Epitrix cucumeris* Harr.) is abundant on everything in the garden, particularly tomatoes and cucumbers though not very destructive. The currant worm is one of the most destructive species at present and the larder beetle (*Dermestes lardarius* Linn.) is quite numerous.—*June 6.* Potato beetles have appeared in small numbers and have been recorded as feeding on tomato plants. The striped cucumber beetle is at work on both squash and cucumber vines but is not doing much injury.—*June 10.* The striped cucumber beetle is very numerous and destructive.—*June 17.* The rose beetle (*Macrodactylus subspinosus* Fabr.) appeared in very large numbers during the last few weeks, attacking trees, grapevines and a large number of other plants. Previously they have been present in small numbers and their depredations confined largely to rosebushes. This year they occurred in swarms in some places, literally covering grapevines and fruit trees, exhibiting a decided partiality for plum. Potato beetles are not very abundant.—*June 24.* The white frothy masses of spittle insects (probably *Philaenus lineatus* Linn. and *P. spumarius* Linn.) are exciting considerable attention because of their abundance. Tent caterpillars (*Mala-cosoma americana* Fabr.) are unusually scarce. The small black flea beetles are very numerous on potatoes, tomatoes, cucumbers and other garden plants.—*June 27.* Potato beetles are very abundant and a second brood of currant worms has appeared. The striped cucumber beetle is present in some numbers and the black flea beetle has nearly disappeared. The latter is also true of the rose beetle. Horn flies (*Haematobia serrata* Rob.-Desv.) are present in swarms and are proving a serious annoyance to cattle.—*July 8.* Cabbage worms (*Pieris rapae* Linn.) are riddling cabbage plants. The striped cucumber beetle is fairly numerous on both cucumber and squash vines. Potato beetles

still continue abundant though not so destructive as in earlier years.—*July 15.* Cabbage worms are very injurious. The striped cucumber beetle continues numerous. Potato beetles are still abundant though easily held in check with paris green. Squash bugs (*Anasa tristis* DeGeer) have not been observed this season though they are usually very destructive.—*July 22.* Cabbage worms continue their injuries. The house fly (*Musca domestica* Linn.) is becoming very abundant. The horn fly is exceedingly annoying to cattle; their sides and the base of their horns are often black with them.—*July 29.* Nests of the fall webworm (*Hyphantria textor* Harr.) are becoming quite abundant. Potato beetles have nearly disappeared. Very few squash bugs have been observed.—*August 12.* Fall webworms are becoming more abundant and destructive.—*August 26*

Warren county [C. L. Williams, Glens Falls] — Larvae of a small midge (*Dasyneura pseudacaciae* Fitch) have been exceedingly abundant in the leaves of a black locust hedge, some portions of which have been so badly infested that nearly every leaf was destroyed. This insect also works to a limited extent on larger trees.—*June 10.* Potato beetles (*Doryphora decim-lineata* Say) are abundant. Rose beetles (*Macrodactylus subspinosus* Fabr.) are disappearing. The elm leaf beetles (*Galerucella luteola* Müll.) continue at work in this locality though they are not more abundant than last year. They are confined largely to the small European elm. There are signs of the insect's work on the trees all over town but only in this locality were specimens found at work. The rather rare galls of *Pemphigus ulmifusus* Walsh are somewhat prevalent on red elm.—*July 6*

Westchester county [F. R. Calkins, Ossining] — Potato beetles (*Doryphora decim-lineata* Say) appeared May 16 and many cabbage butterflies (*Pieris rapae* Linn.) were observed the 19th. The elm leaf beetle (*Galerucella luteola* Müll.) is present in unusually large numbers and the tops of many elms are nearly lifeless owing to the ravenous feeding of the beetles, which left nothing but the veins. The grass fields and lanes present a very peculiar appearance. There are large dead spots here and there and examination reveals no insects beneath (this may possibly be the work of grass webworms, Crambids). Peartrees are in very poor condition, many of them throwing out long suckers. This condition is probably due to psylla

attack combined with severe injury from the extremely cold weather of winter before last. Tent caterpillars (*Malacosoma americana* Fabr.) appeared in larger numbers than last year.—*May 26*. The cottony maple aphid (probably *Pemphigus acerifolii* Riley) is abundant though not much injury has been inflicted at present. The insects are flying considerably. Striped cucumber beetles (*Diabrotica vittata* Fabr.) are increasing in numbers and elm leaf beetles are confining their operations largely to the tops of the trees. Cabbage worms are very abundant and corn root worms (? *Diabrotica longicornis* Say) are proving destructive. Tussock caterpillars (*Hemerocampa leucostigma* Abb. & Sm.) are exceedingly abundant and correspondingly injurious to the maples.—*July 2*. Mosquitos appeared for the first time in large numbers June 26. Black flea beetles (*Epitrix cucumeris* Harr.) are forsaking the tomato plants. Potato beetles are causing some trouble. Plant lice (*Aphis mali* Linn.) are proving quite injurious to apple-trees.—*July 3*. Black flea beetles have again appeared in numbers on tomato plants and the tussock moth females are depositing eggs. Beans except limas are being severely injured by a small green louselike insect (possibly the garden flea, *Smynturus hortensis* Fitch). The young of striped cucumber beetles are exceedingly abundant and plant lice have almost completely destroyed the foliage on many apple-trees. It is very dry and hot and appears to be especially favorable to elm leaf beetles, as the fence tops and sidewalks are literally covered with the grubs seeking favorable places for the final changes to the beetle. The cottony maple aphid (*Pemphigus acerifolii* Riley) or the maple Phenacoccus (*Phenacoccus acericola* King) is proving quite injurious to maple foliage. Tussock moth larvae have devoured all but the main veins of many leaves.—*July 18*. Saddle-back caterpillars (*Sibine stimulea* Clem.) are unusually abundant on corn, devouring the leaves very rapidly.—*September 5*

Wyoming county [W. H. Roeper, Wyoming]—Forest tent caterpillars (*Malacosoma disstria* Hübn.) appeared May 9 and are remarkably scarce. The bud moth (*Metocera ocellana* Schiff.) has caused a great deal of injury in this locality and the codling moth (*Carpocapsa pomonella* Linn.) is inflicting some damage. Another insect (probably the steely flea beetle, *Haltica chalybea* Illig.) is working in grape buds and destroying them.—*June 5*

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST

The following is a list of the principal publications of the Entomologist during the year 1904. Sixty-two are given with the title,¹ place, time of publication and a summary of the contents of each. Volume and page number are separated by a colon, the first superior figure gives the column, and the second the exact place in the column in ninths: e. g. 69: 1076¹⁵ means volume 69, page 1076, column 1, beginning in the fifth ninth, i. e. nearly two thirds of the way down.

Mosquitos or Culicidae of New York State. N. Y. State Mus.

Bul. 79, Entomology 22 (Advance copies issued Oct. 29, complete bulletin with appendix mailed Dec. 10). 1904. 164p. 57 pl.

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The following species are noticed: *Anopheles punctipennis* Say, *A. maculipennis* Meig., *A. crucians* Wied., *Psorophora ciliata* Abr., *Janthinosoma musica* Say, *Culex squamiger* Coq., *C. fitchii* Felt & Young, *C. cantans* Meig., *C. sylvestris* Theo., *C. cantator* Coq., *C. sollicitans* Walk., *C. discolor* Coq., *C. jamaicensis* Theo., *C. taeniorhynchus* Wied., *C. confinis* Arrib., *C. annulatus* Schrank, *C. canadensis* Theo., *C. onondagensis* Felt, *C. atropalpus* Coq., *C. dyari* Coq., *C. territans* Walk., *C. lazarensis* Felt & Young, *C. cinereoborealis* Felt & Young, *C. consobrinus* Felt, *C. absobrinus* Felt, *C. magnipennis* Felt, *C. restuans* Theo., *C. pipiens* Linn., *C. abserratus* Felt & Young, *C. nemorosus* Meig., *C. salinarius* Coq., *C. trivittatus* Coq., *C. serratus* Theo., *C. dupreei* Coq., *C. triseriatus* Say, *C. aurifer* Coq., *C. melanurus* Coq., *Stegomyia signifer* Coq., *Taeniorhynchus perturbans* Walk., *Aedes fuscus* Osten Sacken, *A. smithii* Coq., *Uranotaenia sapphirina* Osten Sacken, *Corethrella brakeleyi* Coq., *Corethra karnerensis* Felt, *C. lintneri* Felt, *C. cinctipes* Coq., *Eucorethra underwoodi* Undw., *Sayomyia punctipennis* Say, *S. trivittata* Loew, *S. albipes* Johans., *S. rotundifolia* Felt, *S. americana* Johans., *S. hudsoni* Felt, *Culex abfitchii* Felt.

The following genera are erected: *Culicelsa*, *Culicada*, *Ecculex*, *Culicella*, *Culiseta* and *Protoculex*.

¹Titles are given as published, and in some instances they have been changed or supplied by the editors of the various papers.

MUSEUM PUBLICATIONS

v. 1 pt1 Economical Mineralogy. pt2 Descriptive Mineralogy. 24 + 536p. 1842.

8 plates additional to those printed as part of the text.

DIVISION 4 GEOLOGY. Mather, W. W.; Emmons, Ebenezer; Vanuxem, Lardner & Hall, James. Geology of New York. 4v. il. pl. sq. Q. Albany 1842-43. *Out of print.*

v. 1 pt1 Mather, W. W. First Geological District. 37 + 653p. 46pl. 1843.

v. 2 pt2 Emmons, Ebenezer. Second Geological District. 10 + 437p. 17pl. 1842.

v. 3 pt3 Vanuxem, Lardner. Third Geological District. 306p. 1842.

v. 4 pt4 Hall, James. Fourth Geological District. 22 + 683p. 19pl. map. 1843.

DIVISION 5 AGRICULTURE. Emmons, Ebenezer. Agriculture of New York; comprising an account of the classification, composition and distribution of the soils and rocks and the natural waters of the different geological formations, together with a condensed view of the meteorology and agricultural productions of the State. 5v. il. pl. sq. Q. Albany 1846-54. *Out of print.*

v. 1 Soils of the State, their Composition and Distribution. 11 + 371p. 21pl. 1846.

v. 2 Analysis of Soils, Plants, Cereals, etc. 8 + 343 + 46p. 42pl. 1849.

With hand-colored plates.

v. 3 Fruits, etc. 8 + 340p. 1851.

v. 4 Plates to accompany v. 3. 95pl. 1851.

Hand-colored.

v. 5 Insects Injurious to Agriculture. 8 + 272p. 50pl. 1854.

With hand-colored plates.

DIVISION 6 PALEONTOLOGY. Hall, James. Palaeontology of New York. 8v. il. pl. sq. Q. Albany 1847-94. *Bound in cloth.*

v. 1 Organic Remains of the Lower Division of the New York System. 23 + 338p. 99pl. 1847. *Out of print.*

v. 2 Organic Remains of Lower Middle Division of the New York System. 8 + 362p. 104pl. 1852. *Out of print.*

v. 3 Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. pt1, text. 12 + 532p. 1859. [\$3.50]

— pt2. 143pl. 1861. [\$2.50]

v. 4 Fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 11 + 1 + 428p. 99pl. 1867. \$2.50.

v. 5 pt1 Lamellibranchiata 1. Monomyaria of the Upper Helderberg, Hamilton and Chemung Groups. 18 + 268p. 45pl. 1884. \$2.50.

— Lamellibranchiata 2. Dimyaria of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 62 + 293p. 51pl. 1885. \$2.50.

— pt2 Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 2v. 1879. v. 1, text. 15 + 492p. v. 2, 120pl. \$2.50 for 2 v.

— & Simpson, George B. v. 6 Corals and Bryozoa of the Lower and Upper Helderberg and Hamilton Groups. 24 + 298p. 67pl. 1887. \$2.50.

— & Clarke, John M. v. 7 Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. 64 + 236p. 46pl. 1888. Cont. supplement to v. 5, pt2. Pteropoda, Cephalopoda and Annelida. 42p. 18pl. 1888. \$2.50.

— & Clarke, John M. v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16 + 367p. 44pl. 1892. \$2.50.

— & Clarke, John M. v. 8 pt2 Paleozoic Brachiopoda. 16 + 394p. 64pl. 1894. \$2.50.

Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. O. 1853.

Handbooks 1893-date. 7½x12½ cm.

In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

New York State Museum. 52p. il. 4c.

Outlines history and work of the museum with list of staff 1902.

NEW YORK STATE EDUCATION DEPARTMENT

Paleontology. 12p. 2c.

Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

Guide to Excursions in the Fossiliferous Rocks of New York. 124p. 8c.

Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the classic rocks of this State.

Entomology. 16p. 2c.

Economic Geology. 44p. 4c.

Insecticides and Fungicides. 20p. 3c.

Classification of New York Series of Geologic Formations. 32p. 3c.

Geologic maps. Merrill, F. J. H. Economic and Geologic Map of the State of New York; issued as part of Museum bulletin 15 and 48th Museum Report, v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. 15c.

— Map of the State of New York Showing the Location of Quarries of Stone Used for Building and Road Metal. Mus. bul. 17. 1897. 10c.

— Map of the State of New York Showing the Distribution of the Rocks Most Useful for Road Metal. Mus. bul. 17. 1897. 5c.

— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form \$3; mounted on rollers \$5. Lower Hudson sheet 60c.*

The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties; also northeastern New Jersey and part of western Connecticut.

— Map of New York Showing the Surface Configuration and Water Sheds. 1901. Scale 12 miles to 1 inch. 15c.

— Map of the State of New York Showing the Location of its Economic Deposits. 1904. Scale 12 miles to 1 inch. 15c.

Geologic maps on the United States Geological Survey topographic base; scale 1 in. = 1 m. Those marked with an asterisk have also been published separately.

*Albany county. Mus. rep't 49, v. 2. 1898. 50c.

Area around Lake Placid. Mus. bul. 21. 1898.

Vicinity of Frankfort Hill [parts of Herkimer and Oneida counties]. Mus. rep't 51, v. 1. 1899.

Rockland county. State geol. rep't 18. 1899.

Amsterdam quadrangle. Mus. bul. 34. 1900.

*Parts of Albany and Rensselaer counties. Mus. bul. 42. 1901. 10c.

*Niagara river. Mus. bul. 45. 1901. 25c.

Part of Clinton county. State geol. rep't 19. 1901.

Oyster Bay and Hempstead quadrangles on Long Island. Mus. bul. 48. 1901.

Portions of Clinton and Essex counties. Mus. bul. 52. 1902.

Part of town of Northumberland, Saratoga co. State geol. rep't 21. 1903.

Union Springs, Cayuga county and vicinity. Mus. bul. 69. 1903.

*Olean quadrangle. Mus. bul. 69. 1903. 10c.

*Becraft Mt with 2 sheets of sections. (Scale 1 in. = $\frac{1}{2}$ m.) Mus. bul. 69. 1903. 20c.

*Canandaigua-Naples quadrangles. Mus. bul. 63. 1904. 20c.

*Little Falls quadrangles. Mus. bul. 77. 1905. 15c.

*Watkins-Elmira quadrangles. Mus. bul. 81. 1905. 20c.

*Tully quadrangle. Mus. bul. 82. 1905. 10c.

*Salamanca quadrangle. Mus. bul. 80. 1905. 10c.

*Buffalo quadrangle. Mus. bul. 99. 1906. 10c.

*Penn Yan-Hammondsport quadrangles. Mus. bul. 101. 1906. 20c.







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